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COMMENTARY

ICAP Taxonomy of Modes of Cognitive Engagement: A Learner-Centered Theory Focusing on Observable Engagement Behaviors

Xiaoqiao Cheng

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"One of the cardinal features of cognitive therapy is that it stubbornly refuses to buy into your sense of worthlessness."
–David Burns

HISTORICALLY, there have been a number of impactful education theories that used the taxonomy as a classification device, such as the Bloom taxonomy of educational objectives and Gagne taxonomy of learning outcomes. The Bloom taxonomy of educational objectives was developed in the 1950s by the U.S. Committee of College and University Examiners under the leadership of Dr. Benjamin Bloom, which categorizes educational objectives into three domains: cognitive, affective, and psychomotor. Among them, the cognitive domain (the main concern of their research) contains six major classes: knowledge, comprehension, application, analysis, synthesis, evaluation. They are arranged in a hierarchical order with the objectives in one class built on the behaviors found in the preceding classes. Its primary purpose is to provide classification of goals of the educational system for all teachers, administrators, professional specialists, and research workers who deal with curricular and evaluation problems (Committee of College and University Examiners, 1956). Gagne's theory approaches learning from the viewpoint of the instruction. Under his taxonomy, the five categories of learning outcomes are verbal information, intellectual skills, cognitive strategies, motor skills, and attitudes, each of which requires necessary conditions to achieve and corresponds to specific principles of instructional events (Gagne, 1984).

Comparatively, ICAP is a more learner-centered theory as it is about how students engage to learn rather than how instructors teach. It describes learning outcomes as a function of the type of activities undertaken by the learners (Chi, 2009). The ICAP taxonomy differentiates four modes of cognitive engagement based on the overt behaviors displayed by students: passive, active, constructive, and interactive, which correspond to differentiable knowledge-change processes: storing, integrating, inferring, and co-inferring. These cognitive processes elicit different changes in the learner's knowledge, resulting in different cognitive outcomes, such as the abilities to recall, apply, transfer, and co-create. Based on this taxonomy, the ICAP hypothesis is proposed that as students become more engaged with the learning materials, from passive to active to constructive to interactive, their learning increase correspondingly (Chi & Wylie, 2014). The ICAP framework provides concrete, operational definitions of student engagement activities and cognitive processes, thus making it useful to researchers and instructors in their design of activities appropriate for their intended research or instruction (Yang, 2023).

ICAP has been empirically validated by numerous laboratory and classroom studies; however, it has been faced with challenges in authentic classroom settings. In a five-year research project, Chi and her associates attempted to translate the theory into practice in a K-12 education environment. Volunteers of the project (frontline teachers) first received training through the ICAP module and then tried to apply their understanding of ICAP in lesson design and class implementation. Findings of the classroom implementation study revealed that students learned significantly more through constructive than active activities but were not successful in achieving the expected outcomes from interactive activities. The article emphasizes that more research is needed on how to facilitate students to collaborate in a co-generative way (Chi et al., 2018).

Since it was introduced to the Chinese education community, ICAP has been experimented in areas such as adult education, junior secondary physics instruction, senior secondary geography teaching, and physical education. Nonetheless, the existing literature shows that ICAP research in China is relatively insufficient. Practical Validation of the ICAP Theory in China: Holistic Module Learning in Shandong 271 Education Group in this issue gives a brief overview of ICAP and suggests that Chinese teachers and instructional designers can use the ICAP framework in observing and analyzing the modes of engagement behaviors of learners to identify problems with learning activity design, in an effort to maximize students' in-class engagement and interaction as well as enhancing the outcomes of learning activities. The authors argue that instructional strategies such as protocol-guided teaching and collaborative group learning for implementing holistic module learning exhibit compatibility with the ICAP hypothesis (Meng et al., 2023). Schools affiliated to 271 Education Group have had successful practice of the holistic module learning model over the years; Nevertheless, there is a lack of theoretical explanation for why this model is capable of encouraging active learning and stimulating higher-order thinking in students. In this sense, the ICAP theory serves to compensate for the gap. We believe that this study is a meaningful endeavor for advancing ICAP research and application in China.

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COMMENTARY

Significance of Assessment in Learning: The Role of Educational Assessment Tools

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"Assessment is today's means of modifying tomorrow's instruction."
–Carol Ann Tomlinson

IT has been widely acknowledged that assessment is an integral part of any effective educational system. It involves a wide variety of methods or tools that educators use to evaluate, measure, and document the academic readiness, learning progress, skill acquisition, and academic results of students. In his Dictionary of Education Evaluation, Tao (1998) defines educational assessment as a process in which educators make objective evaluation of educational activities, processes, and outcomes through systematic information collection and analysis by using practical, scientific methods, with the purpose of supporting students' continuous improvement and providing evidence for educational decision-making.

Assessment of student achievement plays a vital role in instruction, and its main goal is to improve learning (Gronlund, 1998). It is used to diagnose students' cognitive development as well as verifying or modifying the established learning architecture. Essentially, achievement assessment points to promoting student learning outcomes, allowing them a better understanding of their academic levels, and aiding teachers in adjusting instructional strategies to improve class efficacy (Li & Wang, 2022). To optimizing student evaluation, it is imperative to develop effective, workable achievement assessment tools based on specific educational objectives.

In recent years, the combination of summative and formative assessment is well-accepted as a comprehensive, scientific means for evaluating student learning performance and competence development. Formative assessment (carried out at various points during an educational course) is intended to stimulate and evaluate student learning engagement and to provide them with marks of progress and development in the learning process. The primary purpose of summative assessment (carried out at the end of a course) is to record or report an estimate of students' achievements (Morgan & O'Reilly, 2020).

In the context of Chinese education evaluation, the classification of assessment forms is generally based on the time it occurs. Summative assessment is equal to the final examination; formative assessment refers to regular minor tests and assignments such as quizzes, group work, journals, and theme-based debate, which also focus on students' cognitive outcomes (Chen et al., 2012). Despite the intensifying call for a more comprehensive evaluation framework, it is unattainable without appropriate evaluation tools (Zheng et al., 2016). In formative assessment, traditional forms of test may be suitable for the evaluation of content knowledge and basic skills. On the other hand, the evaluation of sophisticated, higher-order competencies necessitates more demanding situational assignments. Generally, the evaluation of students' higher-order skills requires performance assessment, while reactive test questions can only evaluate basic knowledge and skills but can hardly assess students' emotional capability, thinking ability, or learning process. (Shao et al., 2023).

There are two articles addressing the development of assessment tools in this issue. *Developing an Achievement Test on the Subject of "Basic Compounds in the Structure of Living Things*" seeks to create a multiple-choice achievement test with tested validity and reliability for a biology course (Yalinkilic & Gul, 2023). *Development of a Teacher Attitude Scale on Activities Related to Biology and Nature for Mentally Disabled Students* is a study meant to develop a 5-point Likert scale for evaluating the attitudes of pre-service special education teachers towards activities for a mentally retarded group on subjects of biology and nature (Gul et al., 2023). Both assessment tools were validated by empirical data.

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ORIGINAL ARTICLE

Development of an Attitude Scale on Activities Related to Biology and Nature for Mentally Disabled Students

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***Abstract**: The aim of this study is to develop a valid and reliable scale to determine the attitudes towards the activities that can be applied to the mentally retarded students about biology and nature. During the preparation of the draft form of the scale, an item pool was created from relevant literature. Then, these items were presented to expert opinion in terms of language, intelligibility and content. This draft scale with 30 items in 5-point Likert type was applied to 177 pre-service teachers studying in the special education department of the faculty of education at a state university. Item analysis, exploratory factor analysis and confirmatory factor analysis were performed for the data collected after the application. As a result of the analyses, it was revealed that the scale had a five-factor structure consisting of 20 items. Confirmatory factor analysis revealed that the factor structure was compatible with the data. Goodness of fit index values was sufficient. The Cronbach Alpha internal consistency coefficient of the scale was calculated as 0.89. It can be said that the scale is valid and reliable in determining the views of pre-service teachers about the activities to be applied for mentally retarded students. In addition, the scale is suitable not only for teacher candidates, but also for use by teachers and researchers. In addition, different types of samples such as students in other fields at the undergraduate level and special education teachers who take courses related to special education can be included in the study group.*

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Conflict of Interests*: None*

Introduction

BIOLOGICAL science has provided important services for the benefit of people in every period and its importance has increased in our age. Biology education prepares individuals to help them make social, psychological and personal decisions, as well as to help them with their problems such as health, nutrition, environmental protection and love. Biological science does this both by collecting information through research and by explaining the negative effects of humans on this balance by examining the "natural" relationships between living things. Biology is an important basic science with both scientific and social aspects that directly involves human beings (Yetkin, 1998).

In the biology course curriculum, it was emphasized that the students' knowledge, skills, competence and values should be developed in relation to the interactions between science-technology-society-environment. Student-centred education model is dominant in our country and students with special educational needs also benefit from the programs prepared (Özyürek, 2009). Individual differences, which are based on various factors such as heredity, environment, and culture, manifest themselves in various dimensions such as interests, needs, and tendencies. However, this situation includes differences both among individuals and within the individual. Considering these differences, the biology curriculum was prepared by considering the sensitivities regarding individual differences (Ministry of National Education [MoNE], 2018). The MoNE defines the individual in need of special education as "an individual who, for various reasons, differs significantly from her/his peers in terms of individual characteristics and educational qualifications" (MoNE, 2018). Individuals with special educational needs may differ from each other in terms of various types and levels of disability such as mental, emotional, social, physical and communication (Cavkaytar, 2015; Yazici & Sözbilir, 2022). In our country, the number of students with special education needs is high and it is the duty of teachers and society to get these students a good education (Sözbilir et al., 2015). Like individuals with normal development, individuals who need special education can continue their development in their daily lives and participate in social life with the education given to them. Through education, individuals gain the ability to meet their needs, communicate with the people around them, and ultimately become a productive and independent person in society. However, ensuring that individuals live together with healthy individuals is carried out with the education methods applied. Individuals requiring special education include visually impaired, hearing impaired, mentally disabled and gifted individuals. This research includes individuals with mental disabilities. Mental disability is a condition that occurs due to various reasons and affects the life of the individual. In the related literature, mental disability is defined in various

ways. Definitions are made in different ways depending on the reasons for the formation of mental disability or its effects on the individual (Çağlayan, 2014). According to the World Health Organization (WHO), mental disability is a state of cessation or incompleteness of mental development characterized by the low level of skills that contribute to the general level of intelligence, such as cognitive, language, motor and social skills that occur especially during the developmental period (WHO, 1996). Similarly, the indicators of an individual's mental disability are as follows; social inadequacy, being mentally below normal, pauses and interruptions in development, delayed maturation, a structural cause, and an incurable condition (Karaelmas, 1998). Eripek (2012) stated that the most important feature that distinguishes individuals with mental disability from their normal peers is their inability to learn. According to Jensen (1998), the only proof of something learned is memory. Students with mental disabilities forget information faster than children with normal development because they cannot transfer information from short-term memory to long-term memory. Not having the right information about these children who show incompetence in the classroom causes them to be called mischievous or useless. However, Gardner (2013) emphasizes that a mentally disabled student can learn some of them even if they are insufficient in learning some knowledge and skills, or what they learn can be permanent when they use some intelligence areas. The mentally retarded individual may have limited perception difficulties for various reasons. However, each individual has different abilities and potentials with various limitations. Each individual has unique abilities, physical, and mental sensory and social characteristics. In order to eliminate the limitations of students with mental disabilities in their academic skills, these individuals their performance levels, taking into account their training needs. It is necessary to organize and carry out an education and training process that they can use at the highest level. In line with the ages, learning characteristics of these students, education and training processes should be planned. Functional planning of these plans for teaching academic skills considering the limitations in academic skills and these skill areas are literacy, mathematics, science and social sciences. It is quite possible to cover all areas such as information is important (Özok ɑı, 2018). These should be considered, especially in science and nature education (Uslu, 2008). Aslan and Kurt (2021) stated in their study that inclusive students were indifferent to the lesson due to their low learning levels, and they also had problems in crowded classrooms. In the study of Denizli and Uzoğlu (2016), in which they determined the views of science teachers on inclusive education, it was determined that the teachers had problems with the overcrowding of the classroom and the distraction of the students in the lesson.

Nature is a field that plays a very important role in the psychological and physical development of children. Nature and natural elements should be

included outdoors as much as possible for the education of individuals. According to the "Biophilia" hypothesis advocated by Edward Wilson, the genotype of human includes love of nature and the desire to exist in nature. Well; there is an innate and instinctive tendency in human genes to living systems and organisms. Love of living things (Biophilia), loving life and living systems, that is, being together with other living organisms keeps it alive and this situation ensures the continuity of life (Wilson, 1993). Natural areas also play an important role in the development of children's creativity. Researchers have found that children in areas with higher diversity in topography and vegetation designed with natural elements have higher levels of concentration, motor skills and social activities (Uslu & Shakouri, 2012).

Biology and nature-related activities contribute to the cognitive and sensory development of the individual to the extent of their abilities. In addition, such activities psychologically support the development of individuals by giving them a sense of confidence and achievement, so they are accepted as members of the society as they will become productive. One of the biggest indicators of disability, the inability of the disabled individual to participate in the social life, is also destroyed in a sense. It is important not only for the disabled individual but also for the society and family of the disabled individual that the disabled individual participates in a productive activity in terms of education and job opportunities. As the physical and mental abilities of the disabled person are developed, they will be more independent and productive (Uslu, 2012).

Aslan and Kurt (2021), in their study, stated that biology teachers should teach inclusive students primarily the information that will be useful to the student in daily life. They also stated that it is necessary to provide an education based on visuals, where they can learn by doing and experiencing. Akkuş (2019) examined the views of science teachers about inclusive education and found that teachers used learning by doing, visual materials and videos in order to ensure the active participation of inclusive students in the lesson.

In a study conducted in the United States, it was determined that activities performed in areas designed with natural elements cause positive behavioural changes in children with attention disorders. In the same study, it is reported that these activities have a developing and supportive effect on the focusing skills of children with concentration difficulties. In a study conducted in Chicago, it was observed that children move and play more and are more creative in a playground with high vegetation, while they are relatively less active in playgrounds with poor vegetation (Uslu, 2008).

Special education studies in our country have gained momentum in recent years, and in parallel with these studies, some studies have been started in the field of special education (Sözbilir et al., 2015; Terzioğlu, Akbıyık & Yıkmış, 2023). In particular, publications on inclusion and individu-

alized education have been made available to the reader. However, although there are many teachers working in the field of the mentally handicapped, most of the private and public schools provide education for mentally retarded children and there are departments that train teachers for the field, the scales that researchers, teacher candidates and teachers can use on the mentally handicapped and their education are very limited. It is thought that the existence of scales in various disciplines regarding the mentally handicapped will positively affect both the attitudes of the pre-service teachers in the education process and indirectly the quality of the education provided to the mentally handicapped children. Therefore, the aim of this study is to develop a valid and reliable scale to determine the attitudes towards the activities that can be applied to the mentally retarded students about biology and nature.

Method

In this study, a survey method based on a quantitative research paradigm was utilized. The participants of the study consist of 177 teacher candidates studying in the special education department of a state university in 2022-2023 academic year. Of the teacher candidates, 128 are girls and 49 are boys. The ages of the teacher candidates participating in the study ranged from 17 to 25. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were performed on the same sample due to the insufficient number of teacher candidates in the special education department.

Development of the Measurement Tool

The development process of the scale consists of several stages. These stages include (i) creating item pool, (ii) content and face validity, (iii) application, (iv) construct validity, and (v) reliability analysis (**Figure 1**).

During the preparation of the scale, which was developed in order to determine the attitudes of special education teacher candidates towards activities related to biology and nature for the mentally retarded students, a large-scale literature review was conducted on the subject and similar studies were identified (Aslan & Kurt, 2021; Eripek, 2012; Karakaş, 2018; Özyürek, 2009; Uslu, 2012; Uslu & Shakouri, 2012). As a result of the researches on the subject, the scale items were prepared by the researchers who carried out this study, as well as the items taken from the literature. Thus, a 32-item draft form was developed. The draft scale was examined by two faculty members from the subject area and field education experts. Expressions in the scale were evaluated by experts mainly on the basis of simplicity, clarity, fluency, appropriate use of language, spelling of expressions and intelligibility criteria. In line with the suggestions of the experts, the items that are not suitable for the scope or that reduce the face validity were removed from the

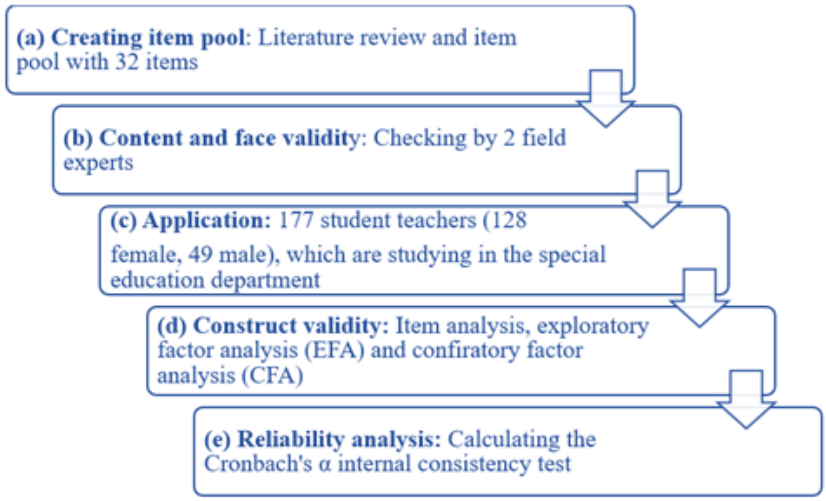

Figure 1. Stages of Scale Development.

draft measurement tool and a draft form of the scale was created out of the remaining 30 items. The items in the draft form of the scale are in 5-point Likert type. All expressions have positive sentence structure.

Validity and Reliability

The draft form of the scale, which was rearranged by making a preliminary examination in line with expert opinions, was applied to the sample group in order to determine the construct validity of the scale, that is, its sub-dimensions, and to determine the level of reliability. Item analysis studies of the attitude scale towards activities related to biology and nature for mentally retarded individuals were carried out with item-scale correlations were examined with Pearson correlation coefficient. Item analysis is the process of determining which items should be included in the developed scale, using various criteria, generally through different statistical techniques (Sunaet et al., 2013). One of the most frequently used analyses in this process is the item-scale total score correlation. In the study, it was examined whether there were items that showed a significant correlation of 0.25 and above with the scale scores as a result of the analysis (Tavşancıl, 2006).

After the item analysis using the SPSS program, the factor structure of the scale was analysed using EFA. EFA is a statistical technique that aims to explain the same construct with fewer variables by gathering together the variables (items) that measure the same construct in the process of collecting

evidence for the construct validity of the scale (Suna et al., 2013; Williams, Brown & Onsman, 2012).

In the EFA, the results of the Bartlett test and Kaiser-Meyer-Olkin (KMO) test were considered for the suitability of the data for factor analysis (Tavşancıl, 2006). It is expected that the Bartlett test result will be significant and the KMO value will be greater than 0.50. In the relevant literature, this value can be evaluated as "good" according to the KMO criterion and indicates that the sample size is sufficient (Leech, Barrett, & Morgan, 2005).

In order to obtain additional evidence for the validity of EFA, CFA based on the structural equation model was performed. The reliability of the final scale obtained after all analyses was examined with the Cronbach Alpha reliability coefficient.

Findings

Item Analysis

In the study, item analysis was performed for each item in the scale. For this purpose, item-total score correlation values explaining the relationship between the scores obtained from the test items and the total score of the test were calculated. According to Özdamar (2004), the fact that the item-total score correlation of the items in the scale is positive and even greater than 0.25 indicates the reliability of the scale. Items that do not comply with this rule are recommended to be removed from the scale. As a result of the item analysis in the study, 2 items (I5 and I26) whose item-total score correlation values were below 0.25 were removed from the scale. Thus, the number of items in the scale was reduced to 28 (**Table 1**).

When the findings in Table 1 are examined, the item-total correlations of the other items in the scale vary between 0.296 and 0.674. Accordingly, it can be said that the scale items are reliable enough to measure similar behaviours.

Construct Validity

The construct validity of the scale was tested with EFA and CFA. Analysis results are presented below, respectively.

Exploratory Factor Analysis (EFA)

In EFA process, first of all KMO value was calculated in order to test the adequacy of the sample. In addition, Bartlett's sphericity value was calculated to examine the suitability of the data for factor analysis. According to the findings, the KMO value of the scale was calculated as .869. Also, Bart-

Table 1. Item-Total Correlations of Items in Scale.

Item No	Item-Total Correlation
I1	0.477
I2	0.296
I3	0.462
I4	0.411
I5	-0.143
I6	0.324
I7	0.481
I8	0.566
I9	0.437
I10	0.526
I11	0.600
I12	0.610
I13	0.542
I14	0.674
I15	0.527
I16	0.500
I17	0.526
I18	0.512
I19	0.612
I20	0.536
I21	*0.575*
I22	*0.528*
I23	*0.430*
I24	*0.548*
I25	*0.488*
I26	0.014
I27	0.552
I28	0.539
I29	0.513
I30	0.523

lett test of sphericity was statistically significant (χ^2=2057.986, df=378). According to these findings, it can be said that the data set is suitable for factor analysis. Afterwards, factor analysis was performed on 28 items using Principal Components analysis and varimax rotation. In determining the number of factors to be kept, the eigenvalue greater than 1 and the scree-test (Field, 2009) criterion were considered. On the other hand, a factor load value of 0.40 was considered to evaluate the suitability of the items.

Item 22, 19, 29, 13, 1, 11 and item 12 were excluded because they were included in two factors and the difference between their values in both

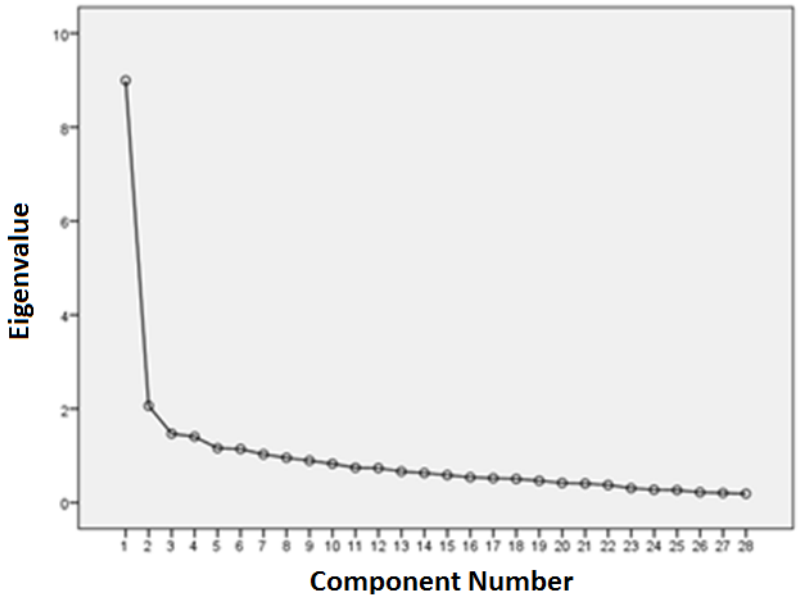

Figure 2. Graph of Scree Plot.

factors was less than 0.10. Additionally, findings from the scatterplot showed that the five-factor structure with an eigenvalue of 1 or higher was more appropriate (**Figure 2**).

According to these results, subsequent analysis was performed. Thus, as a result of the subsequent analyses, it was revealed that the factor loads of 20 items in the scale were above the lower limit of 0.40. In addition, a five-factor structure with eigenvalues of 1 and higher was determined (**Table 2**).

As seen in **Table 2**, the total variance explained for the five-factor structure of the scale is 57.372%. Gürer and Yıldırım (2014) state that it is sufficient for the total variance to be between 40% and 60% and for any factor to be significant, at least 5% of the total variance explained must be attributed to that factor. Therefore, it can be said that the factors in this study explain the variance at a sufficient level. On the other hand, according to EFA results from **Table 2**, factor loads of 6 items in the first factor are between 0.849 and 0.497, factor loads of 4 items in the second factor are between 0.665 and 0.605, factor loads of 4 items in the third factor are between 0.828 and 0.474, factor loads of 4 items in the fourth factor are between 0.845 and 0.520. The factor loads of the 3 items in the fifth factor ranged between 0.821 and 0.630.

According to the item statements, the first factor was named "In-school activities", the second factor was named "Interaction with animals",

Table 2. The Findings for Final EFA.

Factors	Factors Loads
Factor I: In-school activities Eigenvalue: 3.179 Variance: 15.137	
I27: Performing biology-related laboratory activities increases the attitude of mentally retarded individuals towards biology and nature.	0.849
I30: Inviting expert guests in biology and nature (doctor, veterinarian, biologist, etc.) to the class increases the attitude of mentally retarded individuals towards biology and nature.	0.723
I21: Observing animate and inanimate nature elements with a microscope and lens increases the attitude of mentally retarded individuals towards biology and nature.	0.680
I14: Watching documentaries, photographs, slides or movies about biology and nature increases the attitude of mentally retarded individuals towards biology and nature.	0.565
I28: Doing activities aimed at observable change, such as fermenting yoghurt and making pickles, increase the attitude of mentally retarded individuals towards biology and nature.	0.518
I20: Collecting living and non-living things in nature increases the attitude of mentally retarded individuals towards biology and nature.	0.497
Factor II: Interaction with animals Eigenvalue: 2.414 Variance: 11.495	
I9: Going to the zoo increases the attitude of mentally retarded individuals towards biology and nature	0.665
I8: Fishing increases the attitude of mentally retarded individuals towards biology and nature.	0.646
I7: Doing activities that communicate with animals, such as riding horses and swimming with dolphins, increase the attitude of mentally retarded individuals towards biology and nature.	0.609
I25: Participating in swimming and diving activities to watch underwater creatures increases the attitude of mentally retarded individuals towards biology and nature.	0.605
Factor III: Activities related to the sense organs Eigenvalue: 2.340 Variance: 11.143	
I16: Smelling activities such as flowers and spices that will appeal to the sense of smell increase the attitude of mentally retarded individuals towards biology and nature.	0.828
I17: Conducting various fruit and vegetable tasting activities that will appeal to the sense of taste increases the attitudes of mentally retarded individuals towards biology and nature.	0.779
I18: Doing activities by touching various living things and inanimate objects that will appeal to the sense of touch increases the attitude of mentally retarded individuals towards biology and nature.	0.656
I15: Listening to music containing various animal, water and nature sounds that will appeal to the hearing sense increases the attitude of mentally retarded individuals towards biology and nature.	0.474
Factor IV: interaction with plants Eigenvalue: 2.129 Variance: 10.139	
I23: Participating in tree and sapling planting activities increases the attitude of mentally retarded individuals towards biology and nature.	0.845
I6: Doing activities such as planting seeds and collecting fruits and vegetables increases the attitude of mentally retarded individuals towards biology and nature.	0.627
I24: Participation in the camp-picnic event increases the attitude of mentally retarded people towards biology and nature.	0.617
I10: Going to the botanical garden increases the attitude of mentally retarded individuals towards biology and nature	0.520
Factor V: free time activities Eigenvalue: 1.986 Variance: 9.458	
I2: Growing ornamental plants increases the attitude of mentally retarded individuals towards biology and nature.	0.821
I3: Spending time with inanimate elements such as stone, soil, sand increases the attitude of mentally retarded individuals towards biology and nature.	0.658
I4: Observing celestial elements such as stars, clouds and rainbows increases the attitude of mentally retarded individuals towards biology and nature.	0.630
Total variance explained (%): 57.372	

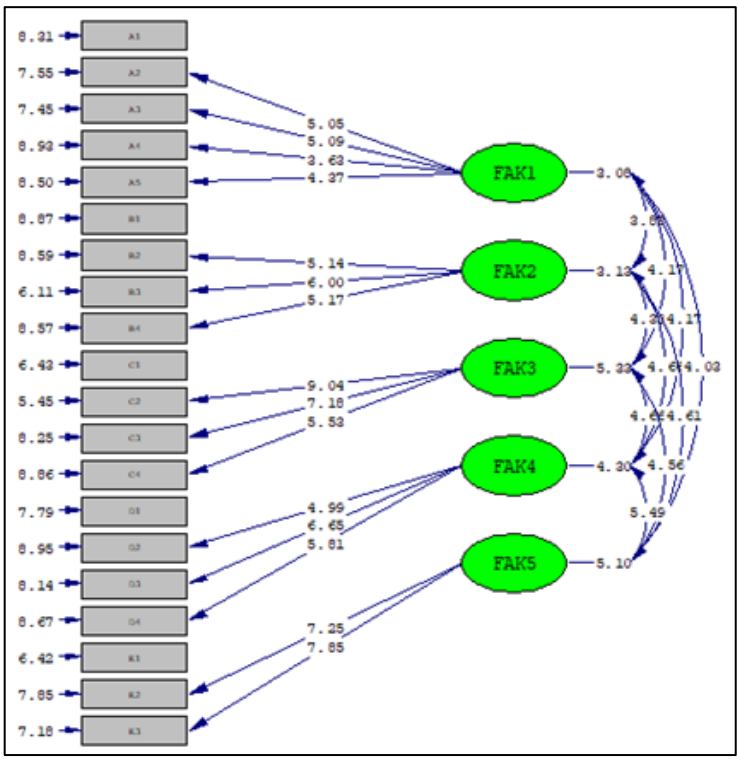

Figure 3. Path Diagram.

the third factor was named "Activities related to the sense organs", the fourth factor was named "Interaction with Plants", and the fifth factor was named "free time activities".

Confirmatory Factor Analysis (CFA)

In the study, CFA was performed to test the accuracy of the structure consisting of five factors as a result of EFA. For this purpose, a path diagram was created for the model that includes 20 items and five factors. At the same time, fit statistics were calculated for the data. For this purpose, each factor and its related items were coded as A1…A6 for the first factor, B1…B4 for the second factor, C1…C4 for the third factor, D1…D4 for the fourth factor, and E1…C3 for the fifth factor. **Figure 3** shows that the standardized factor loads between the items in the original scale and the constructs that the items tend to measure were found to be statistically significant according to the t-test results and all factor loads (Demir & Yurdugül, 2014).

Table 3. Overall Goodness-of-Fit in the Scale.

Overall Goodness-of-Fit Index	Criteria	Application Results	Evaluation Results
	Absolute Fit Indices		
Likelihood-ratio χ2	P < 0.05	373.37	poor
df	-	160	-
GFI	≥ 0.90	0.82	poor
AGFI	≥ 0.90	0.76	poor
RMR	≤ 0.08	0.07	good
SRMR	≤ 0.08	0.08	good
RMSEA	≤ 0.08	0.08	good
	Relative Fit Indices		
NFI	≥ 0.90	0.70	poor
NNFI	≥ 0.90	0.76	poor
IFI	≥ 0.90	0.80	poor
CFI	≥ 0.90	0.80	poor
	Parsimony Fit Indices		
PGFI	≥ 0.50	0.59	good
PNFI	≥ 0.50	0.62	good
Likelihood-ratio χ2/df	≤ 3	2.33	good

As seen in **Figure 3**, it is χ^2=2.33, df=160, and RMSEA=0.087. After the path diagram is drawn, the t values of the items are checked first. If the t value exceeds 1.96, it is considered significant at the 0.05 level, while if it exceeds 2.56, it is considered significant at the 0.01 level. Items with a statistically insignificant t value should be removed from the scale (Şimşek, 2007). In the model we have, the t values of all items are significant, a necessary condition for the model to be acceptable.

Table 3 indicates the fit indices and evaluation results. In the literature, it is recommended to use the χ^2/df ratio, which is called the normed chi-square, since χ^2 is sensitive to sample size. In addition, in large samples, a ratio below 3 is accepted as an indication of perfect fit, and below 5 is an indication of medium level of fit (Şimşek, 2007; Yılmaz & Çelik, 2009). Therefore, it can be said that χ^2/df ratio is good. On the other hand, it is stated in the literature that RMSEA between 0.05 and 0.10 is accepted as an indicator of medium agreement, while values above 0.10 indicate poor agreement (MacCallum, Browne, & Sugawara, 1996). Therefore, in this study, it can be said that the value of 0.08 of RMSEA provides an adequate but borderline fit. More recently, however, a cut-off value close to 0.06 or a solid upper limit of 0.07 appears to be a general consensus among authorities in the field (Hooper, Coughlan, & Mullen, 2008).

According to the literature, CFI, GFI and AGFI values take values between 0 and 1, and closer to 1 indicates perfect fit, and closer to 0 indicates inconsistency (Çokluk, Şekercioğlu & Büyüköztürk, 2010). When **Table 3** is examined, it is seen that these values are weak. According to some researchers, GFI value is less preferred in recent years because it is sensitive to sample size. Also, regarding the GFI, there is AGFI with more saturated models that adjust the GFI to degrees of freedom and reduce the fit. For this reason, it has been recommended not to be used in some studies in recent years (Hooper et al., 2008). Regarding the fit indices, the NFI value was calculated to be low in the study. Similar to GFI, it is a significant disadvantage that NFI is sensitive to sample size, especially for samples less than 200. Therefore, it is recommended to rely on this value alone. RMR, SRMR, PGFI and NNFI seem to have good value. When the findings regarding the fit indices are evaluated in general, it can be said that the model shows an acceptable fit for the most basic indices (such as RMSEA, χ^2/df).

Scale's Reliability

In the study, Cronbach's Alpha coefficient was calculated to determine the overall scale and reliability of each factor. According to the findings, this value (α) is 0.83 for the "In-school activities" factor, 0.68 for the "Interaction with animals" factor, 0.76 for the "Activities related to the sense organs", 0.70 for the "Interaction with Plants" factor and 0.67 for the "free time activities" factor. In addition, it was calculated as 0.89 for the overall Cronbach's Alpha scale. Therefore, it can be said that the scale and its dimensions are quite reliable (Özdamar, 2004).

Discussion

It is a known fact that the most important feature that distinguishes mentally retarded individuals, who are defined as individuals who differ significantly from their peers in terms of their personal characteristics and educational qualifications for different reasons, from their normally developing peers is their inability in learning. However, although mentally retarded students may have inadequacies in learning some knowledge and skills, each individual may have different abilities and potentials with various limitations. It is also emphasized that these individuals can learn some of the knowledge and skills or that what they learn can be permanent when different intelligence areas are addressed (Gardner, 2013). Therefore, enabling individuals with mental disabilities to live together with healthy individuals can be achieved with appropriate educational methods and activities designed for them. Although biology and nature are fields that play an important role in the psychological and physical development of children, it has been determined that

the concentration, motor skills, creativity and social activities of children who are applied activities related to biology and nature are at a higher level (Uslu & Shakouri, 2012). For this reason, it is important to carry out activities related to biology and nature for mentally handicapped students. However, there is a need to evaluate the attitudes of many teachers and preservice teachers working in the field of mental disabilities towards activities related to biology and nature for mentally retarded students. When the literature is examined, no valid and reliable measurement tool developed for the determination of these attitudes has been found. Therefore, in this study, a scale was developed that determines the attitudes of teacher candidates towards activities related to biology and nature for mentally retarded individuals.

After the analyses made in the research, a 5-point Likert-type scale consisting of 20 items and five sub-factors defined as "in-school activities", "interaction with animals", "activities related to the sense organs", "interaction with plants" and "free time activities". When the expressions in the items in the sub-factors are examined, it is observed that they reflect each sub-factor. The total variance explained by the 20-item and five-dimensional structure of the special education teacher candidates' attitude scale towards activities related to biology and nature for mentally retarded individuals is 57.372%. Accordingly, it can be said that the variance explained by the structure of the scale adequately explains the quality it measures. The CFA result, which was carried out to obtain evidence for the validity of the five-factor structure of the scale determined by EFA, also shows that the model is compatible with the data. This finding confirms the idea that the scale has a five-factor structure. In addition, it was calculated as 0.89 for the overall Cronbach's Alpha scale. It can be said that the scale and its factors are quite reliable.

When the findings obtained in the study are evaluated, it can be said that this scale has the qualifications suitable for the purpose. Therefore, it is thought that the scale will help researchers in determining the feelings, thoughts and behaviours of prospective teachers about activities related to biology and nature for mentally retarded individuals. When the studies in the literature about the sub-dimensions obtained from the scale are examined; In some studies, in the literature regarding the "in-school activities" factor, it has been determined that the implementation of different activities in the school contributes positively to the lessons of students with special needs (Çulha, 2010; Güldenoğlu & Kargın, 2012; Güven & Tufan, 2010). Tandoğan (2016), especially the place of natural elements social, physical, emotional, cognitive, movement stated that it had positive effects on their development and creativity. For the "interaction with animals" factor; it has been emphasized that animals motivate people by relieving loneliness and increasing social interactions in people with mental illness or disability, and im-

prove physiological health, normalize and even increase quality of life with their calming effects (Çakıcı & Kök, 2020). Regarding the "activities related to the sense organs" factor, it was emphasized that an understanding of an educational environment should be applied to children with learning disabilities, which they can perceive with their senses of sight, hearing, touch and smell (Uslu & Shakouri, 2012). As a matter of fact, Okcu and Sözbilir (2017) also stated that the use of tools, materials or activities that appeal to different sensory organs of students have positive effects on students' learning. Moreover, looking at nature and experiencing nature in a way by hearing the sounds of nature has a tension and stress-reducing effect, as revealed in many studies (Sam and Kouhirostami, 2020). As for the "interaction with plants" factor, some findings have been obtained in the literature: Vegetable, fruit or ornamental plant production activities have increased the sense of achievement and production for people with physical or mental disabilities. Taking care of production and maintenance works with natural materials such as plants and soil, spending time with plants, which are living and variable materials, means mobility, productivity and success for the disabled. With plant production, a continuous learning process begins in disabled individuals, the need for observation, research, nurturing their sense of curiosity arises, problem solving and decision-making skills and creativity are strengthened (Uslu, 2012). Pouya, Bayramoglu and Demirel (2017) stated that the relationship between need-activity-space while designing school gardens. Organic gardens that will support nature and environmental education by emphasizing the need to question vegetation areas, natural ponds, mud pools, hills and sandboxes, tenting and camping areas, traffic training tracks, animal feeding shelters, large grass surfaces and playgrounds for physical and spiritual development and practice gardens (tactile, auditory and scent gardens) can be designed. According to the "free time activities" factor, it was emphasized that leisure activities improve the motor skills and physical fitness of children with mild mental retardation (Karakaş, 2018).

Conclusion

It can be said that the scale developed as a result of this study is valid and reliable in determining the views of pre-service teachers about the activities to be applied for mentally retarded students. In addition, the scale is suitable not only for teacher candidates, but also for use by teachers and researchers. Similarly, the applications of the research were carried out with teacher candidates. In addition, different types of samples such as students in other fields at the undergraduate level and special education teachers who take courses related to special education can be included in the study group.

In this study, external criterion validity was not examined within the scope of validity studies. Therefore, in order to ensure external criterion va-

lidity in similar measurement tools to be developed in future studies, external criterion validity can be examined with a measurement tool that deals with variables such as gender, age.

The scale developed according to the results obtained in this research was applied to the special education teacher candidates who are related to the special education field. Therefore, it was not possible to collect data from a different sample group for CFA due to the insufficiency of the sample in the relevant area of the study. However, although the inability to perform CFA analysis is considered a limitation of the study, this should not be seen as a disadvantage. On the contrary, these analyses are mostly preferred in scale adaptation studies. However, in a future scale adaptation study on this subject, it may be considered to use CFA and structural equation modelling in addition to EFA.

By applying the scale developed in this study to teachers and researchers who teach students with mental disabilities, a survey study can be carried out in which their opinions are taken. Thus, the usefulness of the scale and the general attitudes of teachers towards these activities can be examined.

Considering the structure of different countries and different cultures, new scales of similar nature can be developed and different dimensions from the scale in this study can be revealed.

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ORIGINAL ARTICLE

Development an Achievement Test on the Subject of "Basic Compounds in the Structure of Living Things"

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***Abstract**: The aim of this study is to develop a valid and reliable achievement test on the subject of 'Basic Compounds in the Structure of Living Things'. During the preparation of the draft form of the test, a 32 item-question pool was created by the researchers in the light of the relevant literature. Then, these questions were presented to expert opinion in terms of language, intelligibility and content. This draft test with 32 multiple choice questions, was applied to 252 students studying at three different high schools. Item difficulty and item discrimination indices were calculated for the data obtained. After the item analysis, seven questions were removed from the test. Thus, the average item difficulty of the 25-question achievement test was calculated as 0.44, and the average item discrimination was 0.44. The KR-20 reliability coefficient of the test was calculated as 0.75. This result shows that the test is of medium difficulty and excellent discriminative reliability. In addition, according to the revised Bloom taxonomy, seven of the questions in the test are at the level of remembering, fifteen at the level of understanding, two at the level of application and one at the level of evaluation.*

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Introduction

SINCE the first day of its existence, humanity has developed many techniques and approaches to meet its basic needs and to be protected against potential enemies, and these techniques and approaches have been passed on to the next generations through education. Educational processes were also utilized in the transfer of knowledge in fields such as mythology, theology, and philosophy as a result of people's transition to a settled order over time and the socio-cultural interactions that developed afterwards (Duran & Barut, 2019). When all these aspects are considered, it is possible to define education as a system that shows continuity in the process between the birth-death line of a person and at the same time transfers knowledge and experience, which include in learning, using, developing and teaching of concepts from science to philosophy, from economy to art (Gökçe, 1996). The term education, etymologically, consists of two Latin words that mean "leading" and "instructing" (Duran & Barut, 2019). The education system, on the other hand, is a systematic approach that offers important outputs in order to be able to think about the current development level of a country and its future position (Saraçoğlu Yıldırım, 2021). Many definitions of the concept of "education" have been made from the past to the present, and these definitions express education as a process in which desired outcomes are achieved in human behavior (Hançer et al., 2021; Kargın & Gül, 2021).

Today, it is more and more important to acquire knowledge and information. The main purpose of our education system is not to convey the existing information exactly, but to enable people to gain skills in accessing information. This requires problem solving, conceptual learning, scientific method skills and high-level cognitive process skills. Science and biology lessons are important lessons in which these skills are gained (Kaptan, 1998).

The importance of knowledge about natural phenomena in our world is emphasized among the competencies that individuals studying in the secondary education biology curriculum in Turkey should have. At the same time, it has been cited that it is not appropriate to evaluate with a uniform technique and method in measurement and evaluation, as time-dependent changes may occur in the interest, attitude and success of students with individual differences in the education process of the biology course (Ministry of National Education [MoNE], 2018).

In assessment and evaluation exams, tools that measure comprehension and understanding should be preferred rather than measurement tools that push students to memorize. In this regard, Bloom's taxonomy is a classification in which different thinking stages are listed. In this classification, students must have completed the lower stages in order to move on to the upper stages. The knowledge, comprehension and application stages require

low-level thinking skills and students use their thinking skills very little. Analysis, synthesis and evaluation stages express high-level thinking skills and are effective in improving students' ability to access knowledge, checking their existing knowledge, recognizing the problems encountered and producing solutions to them (Gündüz, 2009). The revised final form of the original taxonomy consists of two dimensions: knowledge and cognitive processes (Avcı, 2020). Information types are found in the information dimension of the revised Bloom Taxonomy. These; knowledge based on facts, conceptual knowledge, procedural knowledge and metacognitive knowledge. In the cognitive process dimension, how information is used is examined and consists of the stages of remembering, understanding, applying, analysing, evaluating and creating (Krathwohl, 2002). Taxonomy is an approach that allows the classification of the expected achievements from the students as a result of an instruction. This classification follows a sequence from abstract to concrete, from simple to complex, and each stage constitutes a prerequisite for the other (Bümen, 2006).

With the creation of taxonomies, it has become more possible today to prepare training programs to cover high-level skills in these taxonomies and to measure these skills effectively (Koğar, 2022). In this process, many different techniques and measurement tools are used. One of them is multiple choice tests. Multiple choice tests are the preferred measurement tools in the transition to the next level of educational institutions in our country. In multiple-choice tests, which can have four or five options in accordance with the level of education of the student, there is only one correct answer, but wrong answers are placed on the remaining options. Multiple-choice tests are measurement tools that can be easily applied by teachers to students in their classrooms in limited time, but they are very reliable and highly valid measurement tools. In addition, since it is a curriculum that should be taught in schools, it also saves teachers and students in terms of timing. Its ease of application is also an important factor in its preference. Scoring is very objective and gives reliable results (Kargın & Gül, 2021). Thanks to these advantages, multiple choice tests are frequently used in learning environments. On the other hand, with the revision or renewal of curricula, it is seen that studies on measurement and evaluation tools that measure learning outcomes have increased.

In our country, some updates were made in the high school biology course curriculum in 2018. Following these updates, test development studies on biology subjects are encountered. A list of studies is shown in **Table 1**:

When **Table 1** is examined, it is seen that test development studies for the updated curriculum of the biology course are quite limited. However, when the literature is examined, it is noteworthy that test development studies on biology subjects are mostly carried out at lower grade levels within the scope of science courses. For example, one of these studies was con-

Table 1. Test Development Studies on Subjects of Biology Course Curriculum in 2018.

Researchers	Subject	Sample Size	Number of Items	Average Item Difficulty	Average Item Discrimination	KR20 Reliability Coefficient
Çakır & Arı (2022)	The Cell	123	22	0.55	0.44	0.89
Kaya & Gül (2020)	Digestive System	201	25	0.56	0.34	0.91
Görmüş (2021)	Circulatory System	200	35	0.54	0.50	0.88

ducted by Bolat and Karamustafaoğlu (2019) on unit "Systems in our Body". As a result of the analysis of the data obtained from 427 sixth grade students, a 35-item test was developed. The mean item difficulty of the test was 0.552, and the mean item discrimination was 0.486. The reliability coefficient was determined as 0.885.

Karslı et al. (2019) performed a test development study on "Cells and Divisions". As a result of the analyses made with the data collected from 409 7th grade students, a 36-question multiple-choice achievement test was developed. According to the findings, the average difficulty of the test was calculated as 0.478 and the average discrimination as 0.452. In addition, KR-20 reliability coefficient of the achievement test was found to be 0.865.

In another study, Kargın and Gül (2021) developed an achievement test on "Supervisory and Regulatory Systems" and "Sensory Organs". In the study conducted with 212 sixth grade students, a multiple choice achievement test consisting of 40 questions was developed. In the analyses performed, the mean difficulty of the test was calculated as 0.61, and the mean discrimination was calculated as 0.47. The reliability analysis of the test was made with data collected from 178 students. According to the findings obtained, the KR-20 reliability coefficient was calculated as 0.86.

Şentürk and Selvi (2021) performed a test development on subject "Human and Environment". As a result of the analysis of the data obtained from 273 students, a 27-item test was developed. The mean item difficulty of the test was 0.62, and the mean item discrimination was 0.47. The reliability coefficient was determined as 0.82.

When the above studies are evaluated, it can be said that there is a need for test development studies on different biology subjects at high school level. On the other hand, according to the new curriculum, a student who starts taking biology lessons at the secondary education level in Turkey receives training on "common features of living things" and "basic compounds in the structure of living things" under the unit title of "Life Science Biology" in the first year of education. In this unit, inorganic compounds and

organic compounds are included in the subject of basic compounds found in the structure of living things. In these subjects, students are informed in a wide spectrum such as the formation of macromolecules from monomers, the functions of compounds in nature and in the human body (MoNE, 2018).

The subject of "Basic Compounds in the Structure of Living Things" in the 9th grade biology curriculum in our country is also are associated with the unit "General Principles of Heredity" in the 10th grade biology course, "Human Physiology" in the 11th grade, "From Gene to Protein", "Energy Conversions in Living Things", "Plant Biology" and "Living Things and Environment" in the 12th grade. On the other hand, in secondary education chemistry course; it is directly or indirectly related to different fields such as "Interactions Between Chemical Species", "Nature and Chemistry" in 9th grade, "Chemistry is Everywhere" in 10th grade, "Introduction to Carbon Chemistry" and "Organic Compounds" in 12th grade. This situation makes the researches carried out on the subject of basic compounds in the structure of living things remarkable in terms of different sub-branches of biology and chemistry. On the other hand, the fact that the compounds in the subject are micro-scale and that it requires using imagination while learning about molecules and molecule interactions that cannot be seen with the naked eye in the teaching process makes it important to focus on the teaching and assessment-evaluation process of such a difficult subject. Because, at any stage of an education process, a measurement process is carried out to determine the level and quality of learning, and the determination of the level of proficiency of the students on the subject is provided by evaluation on the results achieved (Ada & Baysal, 2018). In addition, knowing the achievement levels of the students in this subject will be effective in learning the next subjects. Multiple-choice tests are frequently used to determine the achievement of students. However, an achievement test developed for the subject of Basic Compounds in the Structure of Living Beings, which is included in the biology curriculum updated in 2018 in our country, has not been found in the literature. It is thought that developing an achievement test that evaluates the achievements of students on this subject will contribute to the literature on measurement and evaluation.

Purpose of the Research

The purpose of this research is to develop a multiple-choice achievement test with tested validity and reliability for the subject of "Basic Compounds in the Structure of Living Beings" in the ninth grade biology curriculum. For this purpose, answers to the following research questions were sought:

1. Is the test developed to determine the success levels of ninth grade students on the basic compounds in the structure of living things valid?

2. Is the test developed to determine the success levels of ninth grade students on the basic compounds in the structure of living things reliable?

Method

In this study, it was carried out with the survey method, which is considered in quantitative research designs. Survey studies are used to obtain information about people's attitudes, beliefs, values, demographic characteristics, behaviors, ideas, habits, desires and other types of information (McMillan & Schumacher, 2010). In this study, the survey method was preferred in order to develop a test that determines the achievement levels of the students.

The sample group in the item analysis phase of the research consists of 252 (144 females, 108 male) students from three schools randomly selected from among secondary schools in a province in the west of Turkey. Of the students participating in the applications, 122 (71 females, 51 male) were selected from the first school, 79 (48 females, 31 male) from the second school and 51 (25 females, 26 male) from the third school. According to this, 57.1% of the students are female and 42.8% male in total. Although there is no equivalence between the schools in terms of the number of students, it is assumed that this distribution will not adversely affect the research findings, since all of the schools are public schools and are located in socio-culturally close regions.

The Development Process of the Achievement Test

While developing the achievement test in the research, the test development steps (determining the purpose of the test, determining the content of the test, making the validity and reliability analyzes of the questions in the test, etc.) recommended by Haladyna (1997) and Kızkapan and Bekaş (2018) were considered. For this, first of all, the purpose of the test was determined in the first step of the test development process. Accordingly, the purpose of the test is to measure achievement in the subject of 'Basic Compounds Found in the Structure of Living Things' in the Life Science Biology unit at the ninth grade level.

After the purpose of the test was determined, the researchers first made a literature review and examined the relevant resources (textbook, test books, internet resources, etc.). As a result of the examinations, a total of 32 multiple-choice questions containing the learning outcomes and concepts of the subject of Basic Compounds in the Structure of Living Beings in the most recently updated ninth grade Biology Curriculum (Ministry of National Education [MoNE], 2018) were prepared.

As stated by Tunç and Kılınç-Alpat (2015), in the process of developing an achievement test, content validity is mostly checked and it is abso-

Table 2. The Specification Table of the Questions in the Draft Achievement Test.

Learning Outcomes	Remembering	Understanding	Application	Analyzing	Evaluating	Creating
Explain the organic and inorganic compounds in the structure of living things.	Q2, Q3, Q10, Q13, Q22, Q23, Q24	Q1, Q5, Q6, Q7, Q11, Q12, Q14, Q16, Q19, Q20, Q21, Q26, Q30	Q4, Q8, Q9, Q15	Q18, Q25	Q17, Q29	-
Establishes the relationship between lipids, carbohydrates, proteins, vitamins, water and minerals with healthy nutrition.	-	Q28, Q31, Q32	-	-	Q27	-

Table 3. Item Analysis Results of the Achievement Test.

Question	$C_{Lower\ group}$	$C_{Upper\ group}$	pj	rjx	Question	$C_{Lower\ group}$	$C_{Upper\ group}$	pj	rjx
Q1	18	62	0.59	0.65	Q17	12	9	**0.15**	**-0.04**
Q2	29	62	0.67	0.49	Q18	10	6	**0.12**	**-0.06**
Q3	19	61	0.59	0.62	Q19	13	47	0.44	0.50
Q4	23	42	0.48	0.28	Q20	9	44	0.39	0.51
Q5	17	46	0.46	0.43	Q21	4	17	**0.15**	**0.19**
Q6	16	59	0.55	0.63	Q22	8	31	**0.29**	0.34
Q7	35	61	0.71	0.38	Q23	14	48	0.46	0.50
Q8	15	18	**0.24**	**0.04**	Q24	8	41	0.36	0.49
Q9	14	41	0.40	0.40	Q25	10	18	**0.21**	**0.12**
Q10	17	29	0.34	**0.18**	Q26	13	50	0.46	0.54
Q11	9	52	0.45	0.63	Q27	14	12	**0.19**	**-0.03**
Q12	14	40	0.40	0.38	Q28	16	27	0.32	**0.17**
Q13	8	44	0.38	0.53	Q29	9	35	0.32	0.38
Q14	7	41	0.35	0.50	Q30	14	34	0.35	**0.29**
Q15	14	21	**0.26**	**0.10**	Q31	17	50	0.49	0.49
Q16	19	38	0.42	0.28	Q32	17	41	0.43	0.35
Owerall								0.44	0.44

$C_{Lower\ group}$: Number of students who answered correctly in the lower group
$C_{Upper\ group}$: Number of students who answered correctly in the upper group

lutely taken into account to what extent the questions in the test represent the relevant content. When the literature is examined, it is a frequently preferred method to consult an expert in determining the content validity of a test (Çalık & Ayas, 2003; Treagust, 1988). Thus, in line with expert opinions, information can be obtained about whether the test can measure the feature it

wants to measure, and it can be re-focused on incomplete or contradictory statements (Çalık & Ayas, 2003). From this point of view, the achievement test prepared by the researchers of this study was examined by two faculty member and a biology teacher in terms of language, content, appearance, content, etc. Minor revisions were made in a few questions in the test in line with expert opinions. At the same time, the questions were distributed according to the steps in the revised Bloom's taxonomy (**Table 2**).

According to **Table 3**, seven of the 32 questions are in the remembering, sixteen in the understanding, four in the application, two in the analyzing and three in the evaluating stage.

After expert opinion, the test was applied to 252 students for validity and reliability analysis. During the face-to-face applications, students were prevented from cheating and necessary warnings were made. In addition, it was promised to the students that the application is for research purposes, that their answers will be kept confidential and that the scores will not be used in evaluation in any way. Students were given one class hour (40 minutes) to administer the test. The results of the validity and reliability analysis on the collected data are presented in the findings section.

Findings

After the test was administered to 252 students after expert opinions, item difficulty and item discrimination indices were calculated. For this, the students were divided into 27% lower group and upper group according to their test scores. Accordingly, the answers of 68 students from each group were analyzed (**Table 3**).

Item difficulty index (pj) is the percentage of participants in the upper and lower groups who answered the item correctly. The discrimination index (rjx) is the ability of a test item to distinguish between high- and low-level participants. Assimi et al. (2022) stated that items with pj > 70% were classified as very easy, and items with pj < 30% were classified as difficult. In addition, items with rjx $\leq$ 0.20 are classified as poor, between 0.21 and 0.34 acceptable or good, and $\geq$ 0.35 excellent.

According to **Table 3**, the item difficulty index value was determined as difficult for eight questions (S8, S15, S17, S18, S21, S22, S25, and S27). All other questions are of medium difficulty. In terms of item discrimination values, ten questions (S8, S10, S15, S17, S18, S21, S25, S27, S28, and S39) were discriminating at a weak level and the others at a good or excellent level. Accordingly, seven questions (S8, S15, S17, S18, S21, S25, and S27) whose both item difficulty index and discrimination index were below the desired limits were excluded from the test. On the other hand, S22 was left out of the test because the item difficulty index was borderline and the item discrimination level was good. S10, S28, and S30 were left in the test, al-

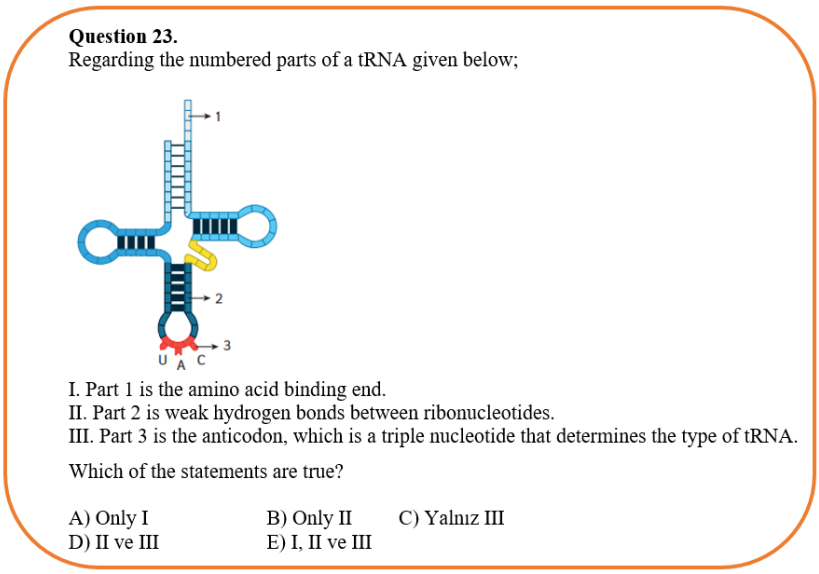

Figure 1. An Example Question of the Achievement Test.

though the item discrimination levels were a little low, because the difficulty indexes were within the desired limits and there were few questions in the learning outcome related to that subject in the test. As a result, the average item difficulty of the achievement test, which includes a total of 25 questions, was calculated as 0.44, and the average item discrimination was calculated as 0.44. The KR-20 reliability coefficient of the test was calculated as 0.75. This result shows that the test is of medium difficulty and excellent discriminative reliability.

An example question of the achievement test is shown in **Figure 1**.

In addition, according to the revised Bloom taxonomy, seven of the questions in the test are at the level of remembering, fifteen at the level of understanding, two at the level of application and one at the level of evaluating. As such, the questions in the test were renumbered and the specification table showing the learning outcomes and the level in the revised Bloom taxonomy is presented in **Table 4**. The final form of the test is given in **Appendix I**.

Discussion

Determining how much of the information transferred to the students in the learning environment can be determined by measuring their academic achievement. However, it is very important to develop tests with high valid-

Table 4. The Specification Table of the Questions in the Final Form of the Achievement Test.

Learning Outcomes	Description of learning outcomes	Questions	Bloom taxonomy
Explain the organic and inorganic compounds that make up the structure of living things.	The importance of water, minerals, acids, bases and salts for living things is explained.	Q2 Q6 Q7 Q11 Q12 Q18 Q25	Remembering Understanding Understanding Understanding Understanding Evaluating Understanding
	The importance of calcium, potassium, iron, iodine, fluorine, magnesium, sodium, phosphorus, chlorine, sulfur and zinc minerals for living things is emphasized.	Q11 Q12 Q18	Understanding Understanding Evaluating
	The structure and function of carbohydrates, lipids, proteins, nucleic acids, enzymes and their importance for living things are explained.	Q9 Q10 Q13 Q14 Q16 Q23	Applying Remembering Remembering Understanding Understanding Remembering
	It is emphasized that DNA is found in all living species and contains the same nucleotides.	Q10	Remembering
	Without including the chemical formulas of ATP and hormones, its importance for living things is questioned.	Q17 Q22 Q24	Understanding Remembering Remembering
	General properties of vitamins are given. The functions of vitamins A, D, E, K, B and C and their importance for living things are explained. The types of B group vitamins are not mentioned.	Q3 Q5 Q19 Q20	Remembering Understanding Understanding Understanding
	Students are provided to carry out experiments in which they can detect the presence of carbohydrates, lipids and proteins in foods.	Q9	Applying
	Experiments on factors affecting enzyme activity are provided.	Q1 Q4	Understanding Applying
Establishes the relationship between lipids, carbohydrates, proteins, vitamins, water and minerals with healthy nutrition.	Insulin resistance, diabetes, and obesity are addressed in the context of healthy eating.	Q8 Q21	Understanding Understanding
	Students are provided to prepare a one-week healthy nutrition program for their age group.	Q15	Understanding

ity and reliability that are compatible with learning outcomes in order to determine the level of achievement and evaluate the effectiveness of the program. In this study, it is aimed to develop a valid and reliable multiple-choice test on the ninth grade 'Basic Compounds Found in the Structure of Living Things'.

Considering that achievement tests are used as a tool in research to measure students' achievement, it is important that these tests are valid tests in terms of content and construct (Üçüncü & Sakız, 2020). The stages followed in the achievement tests developed in the literature are similar to this

study (Açıkgöz & Karslı, 2015; Bolat & Karamustafaoğlu, 2019; Haladyna, 1997; Kargın & Gül, 2021; Kızkapan & Bekaş, 2018). For example; Açıkgöz and Karslı (2015) explained the processes followed in the achievement test developed on business and energy in eight steps. At these stages, the purpose and content of the test were determined by considering the findings of the studies on the subject. In the following processes, a specification table was prepared and the features that could be measured by the test were determined. Thus, a 32-question draft test was prepared, considering the learning outcomes related to the subject. The draft test was presented to the expert opinion and then applied to the students. Thus, the studies for content validity were examined in detail, the application of the draft form and the item analyzes made as a result of this application were included. A similar study was conducted by Can Şen and Eryılmaz (2011), on simple electrical circuits. While developing the achievement test, these researchers followed a six-stage path: determining the learning outcomes, preparing the specification table, creating the test items, preparing the draft form by taking expert opinion, performing the item analysis by applying the draft form, and creating the final form. However, due to the fact that the questions were examined by a small number of experts, it is considered as a limitation of this study that it is not determined whether the agreement between the expert opinions taken to ensure the content validity proposed by Akbulut and Çepni (2013) and Üçüncü and Sakız (2020) is valid.

In the process of developing the achievement test in the study, first of all, a total of 32 questions were prepared by examining the literature by the researchers. While preparing the questions, the learning outcomes specified in the ninth grade Biology Curriculum (MoNE, 2018) were considered. Atılgan et al. (2011) recommends writing three items for each learning outcome in the specification table while preparing the draft form for the test items. From this point of view, at least three questions were prepared for each learning outcome in this study. Thus, the content validity of the test was tried to be increased. In addition, the opinions of experts consisting of a biology teacher and two faculty members were taken to test the content validity of the test. After the content validity study, the draft test for item analysis was applied to 252 students. After the item analysis, the average difficulty of the test, which was reduced to 25 questions, was calculated as 0.44, and the average item discrimination was calculated as 0.44. According to Assimi et al. (2022), these results show that the test has medium difficulty and excellent discrimination.

In the development of achievement tests, it is necessary to determine the learning outcomes to be examined by the test and the question types appropriate for the cognitive levels expressed by these learning outcomes (Üçüncü & Sakız, 2020). As a matter of fact, Özkan & Yadigaroğlu (2020) also argue that the renewed Bloom Taxonomy should be included in addition

to validity and reliability studies while preparing the test. Thus, it is possible to classify the test items in a more understandable and detailed manner. In addition, Bloom's taxonomy cognitive domain classification is frequently used in the field of education because it allows the aims of the items to be clearly and observable (Ayvacı & Türkdoğan, 2009). When the findings of this study are examined, according to the revised Bloom's taxonomy, seven of the questions in the test are at the level of remembering, fifteen at the level of understanding, two at the level of application and one at the level of evaluating. When the seven questions that were removed as a result of the item analysis were examined; it is at understanding level one question (Q21), applying two questions (Q8, Q15), analyzing two questions (Q18, Q25) and evaluating two questions (Q17, S27). Therefore, the fact that the questions measure high-level knowledge according to Bloom's taxonomy caused the students not to be able to answer the questions correctly. As a matter of fact, item difficulty index values show that these questions are difficult. In addition, the findings of the item analysis revealed that the discrimination of the questions was low. Therefore, it was decided to exclude these questions from the test.

According to the findings of the study, the KR-20 reliability coefficient is 0.75. Accordingly, it can be said that the test is reliable. The findings of many of the test development studies in the literature (Kargın & Gül, 2021; Nacaroğlu et al. 2020, Özcan et al. 2019; Özkan, & Yadigaroğlu, 2020; Soylu et al., 2020; Timur et al., 2019) are similar to the findings of this study and reveal that the developed tests are reliable.

Conclusion and Suggestions

As a result of the validity and reliability analyzes in the study, it is seen that the 25-question achievement test measures all the learning outcomes in the curriculum. Accordingly, while there are three questions in the second learning outcome of the subject "Basic Compounds in the Structure of Living Beings", all of the other questions are included in the first learning outcome. However, considering the subject content in the curriculum, it is normal that the questions are not evenly distributed over the learning outcomes. Because, according to the curriculum, most of the subjects and concepts are included in the first learning outcome. Therefore, it is thought that the achievement test is compatible with the learning outcomes in the biology curriculum and completely covers the content in the curriculum. From this point of view, it is thought that the achievement test developed in this study will provide detailed information about the learning levels of the students. In addition, since the reliability and validity of the test have been measured, it can be used by biology education researchers in scientific studies. At this point, it is thought that the test will help to compare the achievement of the student groups

formed by the researchers in experimental studies. On the other hand, no achievement test was found for the ninth grade biology lesson 'Basic Compounds Found in the Structure of Living Beings' in accordance with the objectives of the biology curriculum updated in 2018. It is thought that this study can serve as an example for different tests to be prepared at the ninth grade level in the curriculum. Of course, in the light of these findings reached within the scope of the study, considering some of the limitations encountered in the research process, it is considered appropriate to make some suggestions to guide future research. Accordingly, recommendations are presented below:

- During the development process of the achievement test in the study, the commonly preferred stages in the literature were followed. However, due to the participation of very few experts, the compatibility of these opinions could not be examined by taking the expert opinions for the content validity of the test. Therefore, in a similar study to be carried out in the future, new tests can be developed by considering the criteria (Lawshe technique) that Webb (1997) put forward to ensure the harmony between learning outcomes and exams.
- Since multiple-choice tests are insufficient to measure knowledge at the higher levels of the cognitive domain, no questions at the creating level could be prepared in the test developed in this study. For this reason, when the test is used to measure students' achievement levels, an appropriate open-ended question can be added to the creating level.
- In the study, as a result of item analysis, the questions at the analyzing level were excluded from the test. In future research, new achievement tests with questions at analyzing level can be developed. In addition, two or three-stage multiple-choice tests can be developed.
- As stated by Ozcan et al. (2019), while selecting the sample in the process of developing achievement tests, it is thought that choosing the sample number from large schools with different achievement levels will increase the validity of the study. For this reason, it can be recommended to develop and apply tests that can appeal to wider audiences by selecting schools with different achievement levels in similar studies to be carried out in the future.

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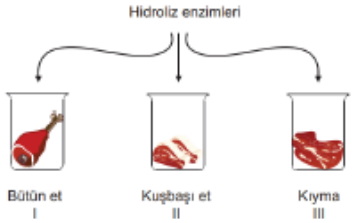
APPENDIX I. Final Form of Achievement Test.

Adı-Soyadı:

Sınıfı:

'CANLILARIN YAPISINDA BULUNAN TEMEL BİLEŞİKLER' BAŞARI TESTİ

S.1) Aşağıdaki deneyde aynı miktarda et; bütün, kuşbaşı ve kıyma haline getirilip kaplara konulduktan sonra üzerlerine hidroliz enzimleri ilave edilmiştir.



Deneyin sonunda kaplardaki ürün oluşum hızı ve nedeni hangisinde doğru olarak verilmiştir?

	Ürün Oluşum Hızı	Nedeni
A)	III > II > I	Substrat yüzeyi farkı
B)	III > II > I	Substrat yoğunluğu farkı
C)	I > II > III	Substrat yüzeyi farkı
D)	I > II > III	Substrat yoğunluğu farkı
E)	III > I > II	Substrat yüzeyi farkı

S.2) Asitlerle ilgili olarak aşağıda verilenlerden hangisi yanlıştır?

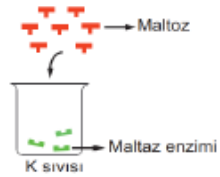
A) Tatları ekşidir.
B) pH değerleri 7'nin altındadır.
C) Sulu çözeltilerine OH^- iyonu verir.
D) Mavi turnusol kâğıdını kırmızıya çevirir.
E) Bazlarla birleştiğinde tuzları oluşturur.

S.3)
- İnce bağırsak ve böbreklerden Ca^{2+} emilimini kolaylaştırır.
- Kemiklere Ca^{2+} geçişini sağlayarak kemiklerin güçlenmesini sağlar.
- Eksikliğinde çocuklarda raşitizm, yetişkinlerde osteomalazi hastalığı görülür.

Bazı özellikleri yukarıda verilen vitamin çeşidi aşağıdakilerden hangisidir?

A) A vitamini B) B vitamini C) C vitamini
D) D vitamini E) E vitamini

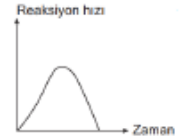
S.4) Aşağıda gösterildiği gibi sınırlı miktarda maltaz enzimi bulunan bir deney tüpüne, sürekli maltoz ilave edilmektedir.



Buna göre reaksiyon hızı-zaman grafiği aşağıdakilerden hangisinde doğru olarak verilmiştir?

A)


B)


C)


D)


E)


S.5)

I. B vitamini
II. C vitamini
III. K vitamini
IV. A vitamini

Yukarıda verilen vitamin çeşitlerinin eksik alınması durumunda belirecek,

a. kansızlık
b. skorbüt
c. kanın pıhtılaşmaması
d. gece körlüğü

hastalıklarının doğru eşleştirilmesi aşağıdaki seçeneklerin hangisinde gösterilmiştir?

	I	II	III	IV
A)	a	b	c	d
B)	a	c	b	d
C)	b	d	a	c
D)	b	c	d	a
E)	c	a	d	b

S.6) Depresyon, diş çürüğü, egzama, saç dökülmesi gibi rahatsızlıkların nedeni vücudumuzdaki asit baz dengesinin bozulmasıdır.

Bu durum, asit ve bazların aşağıda verilen hangi özelliğinden kaynaklanır?

A) Sindirim için ortam oluşturmaları
B) Enerji vermeleri
C) Homeostasiyi etkilemeleri
D) İnorganik olmaları
E) Hücre zarından geçebilmeleri

S.7) Böceklerin su üzerinde yürüyebilmeleri suyun;

I. öz ısısının yüksek olması,
II. sıvı hâlden gaz hâline geçebilmesi,
III. besin maddeleri için iyi bir çözücü olması,
IV. su molekülleri arasında oluşan hidrojen bağlarının neden olduğu yüzey gerilimi özelliklerinden hangileri ile açıklanabilir?

A) II ve III B) Yalnız IV C) III ve IV
D) Yalnız II E) Yalnız I

S.8) Aşırı tatlı yeme isteği sebebiyle doktor muayenesine giren hastaya tip II diyabet teşhisi konmuştur.

Yukarıda yer alan bilgi dikkate alındığında aşağıdakilerden hangisi söylenemez?

A) Homeostazi zaman içinde birtakım faktörlere bağlı olarak bozulabilir.
B) Bu hastalık genetik yolla sonraki nesillere aktarılır.
C) Hastanın uygun olmayan beslenme tarzına sahip olduğu düşünülebilir.
D) Tedavi için insülin hormonunun direnci ortadan kaldırılmalıdır.
E) Hastalık obezite kaynaklı ortaya çıkmış olabilir.

S.9)

I. Protein
II. Protein ayıracı
III. Protein yıkan enzim
IV. Aminoasit
V. Aminoasit ayıracı

"Aminoasitler proteinlerin yapı taşlarıdır." hipotezini kanıtlamak için düzenlenen bir deneyde, yukarıdakilerden hangilerinin birlikte kullanılması gerekmektedir?

A) I ve II B) I ve III C) III ve I
D) III ve V E) I, III ve V

S.10) Aşağıdakilerden hangisi DNA ve RNA'nın ortak özelliklerinden biridir?

A) Her birinin yapısında tüm pirimidin baz çeşitleri yer alır.
B) Her iki molekül de nükleotit polimeridir.
C) Her zaman zarlı organel içerisinde bulunurlar.
D) Zincirlerindeki pürin ve pirimidin bazlarının sayıları her zaman birbirine eşittir.
E) Hücre döngüsünde replikasyon geçirirler.

S.11)

I. Klorofil pigmentinin yapısına katılır.
II. Hemoglobin pigmentinin yapısına katılır.
III. Tiroksin hormonunun yapısına katılır.

Yukarıda görevleri belirtilen mineral çeşitleri aşağıdakilerden hangisinde doğru verilmiştir?

	I	II	III
A)	Demir	Magnezyum	İyot
B)	Magnezyum	Bakır	Demir
C)	Demir	Bakır	İyot
D)	İyot	Magnezyum	Demir
E)	Magnezyum	Demir	İyot

S.12) Aşağıda verilen mineral çeşitleri ve görevleri ile ilgili eşleştirmelerden hangisi yanlıştır?

A) Kalsiyum → Kemik ve diş yapısına katılma
B) Fosfat → DNA, RNA ve ATP yapısına katılma
C) Sodyum → pH ve su dengesini sağlama

D) Klor → Mide özsuyu oluşumunda
E) Çinko → Çizgili kaslardaki miyoglobin yapısına katılma

S.13) Hücre zarının yapısında en fazla bulunan lipit çeşidi aşağıdakilerden hangisidir?

A) Glikolipit B) Steroit C) Fosfolipit
D) Kolesterol E) Trigliserit

S.14)

x – Riboz
y – Glikoz
z – Galaktoz
k – Deoksiriboz
m – Fruktoz

Yukarıda bazı karbonhidrat çeşitleri verilmiştir.
Buna göre,

I. x ve y
II. y ve z
III. z ve m
IV. y ve m
V. x ve k

ikililerinden hangilerinin birleşmesi bir disakkarit oluşumu ile sonuçlanabilir?

A) I ve III B) II ve IV C) I, II ve V
D) II, III ve IV E) II, III, IV ve V

S.15) Aşağıdaki yiyecek guruplarından hangisinde dengeli beslenme için gerekli besinler, diğerlerine göre daha fazla bulunmaktadır?

A) Nohut – pilav – yoğurt
B) Etli nohut – pilav – baklava
C) Etli nohut – pilav yoğurt
D) Etli nohut – pilav – salata
E) Köfte – patates – pilav – baklava

S.16) Aşağıda verilen özelliklerden hangisi doymuş yağ asitlerinde görülürken doymamış yağ asitlerinde görülmez?

A) Ortam pH'sını düşürme
B) Karbon atomları arasında çift bağ bulundurma
C) Oda sıcaklığında katı hâlde bulunma
D) Kimyasal sindirime uğramama
E) Nötral yağların yapısına katılabilme

S.17) Hormonlar;

I. Hücrelerde kendilerine özgü reseptörlerin bulunabilmesi
II. Organik yapıda olma,
III. Düzenleyici olarak görev yapma,
IV. Bazı çeşitlerinin sindirilebilmesi
Özelliklerinin hangileri yönüyle vitaminlere benzerler?

A) I ve IV B) II ve III C) I, II ve IV
D) I, III ve IV E) II, III ve IV

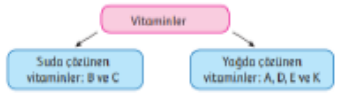
S.18) Bitkilerde bazı minerallerin bitki gelişimi üzerine etkisi ile ilgili bir tablo aşağıda verilmiştir. Tablodaki her bir "+" sembolü birim miktar gelişmeyi ifade etmektedir.

Mineral madde durumu	Bitki gelişimi
K + N + Cl + Fe + Ca	+ + + + +
K yetersiz	+ +
Cl yetersiz	+ + + +
Fe yetersiz	+ +
Ca yetersiz	+ + +
N yetersiz	+

Tablodaki bilgilere göre bitkinin gelişmesi üzerine **en etkili** olan mineral aşağıdakilerden hangisidir?

A) K B) Cl C) Fe
D) Ca E) N

S.19)



Vitaminlerin sınıflandırılması yukarıda verilmiştir.
Buna göre;
Vitamin grupları ile ilgili aşağıda verilenlerden hangisi yanlıştır?

	Suda Çözünenler	Yağda Çözünenler
A)	Depolanmazlar	Depo edilirler.
B)	Fazlası idrarla atılır	Fazlası depolanabilir.
C)	Eksikliği hemen anlaşılır.	Eksikliğinin anlaşılması uzun sürer.
D)	Emilimi sulu ortamda olur.	Emilimi yağlı ortamda olur.
E)	Ototroflar üretemezler	Ototroflar üretirler.

S.20) Suda ve yağda çözünen vitaminlerin,

I. Depolanabilmeleri
II. Düzenleyici olmaları
III. Organik yapıda olmaları
IV. Sindirilmemeleri

özelliklerinden hangileri ortak değildir?

A) Yalnız I B) Yalnız IV C) I ve III
D) II ve IV E) II, III ve IV

S.21)

Tarhananın yapımı sırasında mayalanması protein, karbonhidrat ve yağların bakteri kültürleri tarafından ön sindirime uğraması tarhananın daha kolay sindirilmesi ve daha besleyici özellik kazanmasını sağlamaktadır. Tarhananın glisemik indeksinin 20 olduğu bilinmektedir. Glisemik indeks, besinlerin vücuda alındığında kan şekerini yükseltme hızını ifade eden indekstir. Glisemik indeksi düşük besinler, kan şekerini yavaş yükselterek özellikle şeker hastalığına karşı koruyucu etki sağlar. Ayrıca tarhananın probiyotik özellikte olduğu düşünülmektedir. Probiyotikler besinlerle belirli miktarlarda alındığında bağırsak florasını dengeleyip insan sağlığını olumlu yönde etkileyen canlı organizmalardır. Tarhana içerdiği lif ile kanın kolesterol seviyesinin dengede tutulmasına yardımcı olur ve kolon kanseri riskini azaltır.

Yukarıda tarhana ile ilgili verilenlerden hangisi çıkarılamaz?

A) Sindiriminin daha kolay olması
B) Glisemik indeksinin düşük olması
C) Probiyotik bakımından zengin besin olduğu
D) Kan kolesterol seviyesini dengede tuttuğu
E) Bazı mikroorganizmalara karşı antibiyotik özellik gösterdiği

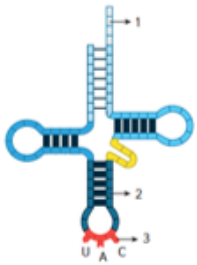
S.22)
İnsanlarda hormonlarla ilgili;

I. Büyüme, farklılaşma ve metabolizma gibi fizyolojik olayların düzenlenmesinde görev alırlar.
II. Endokrin bezlerden salgılanırlar.
III. Tamamı protein yapılı olup DNA kontrolünde sentezlenirler.

yargılarından hangileri yanlıştır?

A) Yalnız I B) Yalnız II C) Yalnız III
D) I ve II E) II ve II

S.23)
Aşağıda şekli verilen bir tRNA'nın numaralandırılan kısımları ile ilgili;

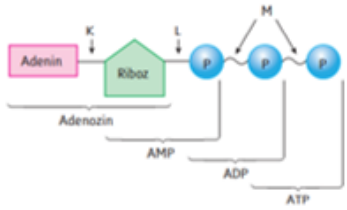


I. 1 nolu kısım aminoasit bağlanan ucudur.
II. 2 nolu kısım ribonükleotitler arasındaki zayıf hidrojen bağlanıdır
III. 3 nolu kısım tRNA'nın çeşidini belirleyen 3'lü nükleotit olan antikodonudur.

Yargılarından hangileri doğrudur?

A) Yalnız I B) Yalnız II C) Yalnız III
D) II ve III E) I, II ve III

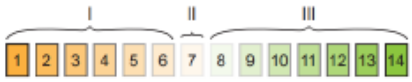
S.24)



Bir ATP molekülündeki K, L ve M ile gösterilen bağlar aşağıdakilerden hangisinde doğru verilmiştir?

	K	L	M
A)	Glikozit	Ester	Fosfat
B)	Peptit	Ester	Glikozit
C)	Ester	Glikozit	Fosfat
D)	Glikozit	Fosfat	Ester
E)	Fosfat	Peptit	Peptit

S.25) Aşağıda bir pH metre verilmiştir.



Buna göre I, II ve III bölgelere ait örnekler hangi seçenekte doğru verilmiştir?

	I	II	III
A)	Karbondioksit	Amonyak	Su
B)	Elma	Maden suyu	Kahve
C)	Amonyak	Su	Karbondioksit
D)	Gazoz	Su	Brokoli
E)	Gazoz	Amonyak	Elma

TEST BİTTİ

ORIGINAL ARTICLE

Investigation of the Relationship between Middle School Students' Motivation and Attitudes toward Social Studies

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***Abstract**: The two most important affective skills that influence students' success in a course are motivation and attitude. The desire to achieve a specific goal is related to motivation, while the experiences gained in the pursuit of that goal shape one's attitude. The high motivation of students for a course is also an indicator of their positive attitudes toward that course. This study aims to determine the predictive power of 6th-grade middle school students' attitudes toward the social studies course on their motivation to engage in this course. A correlational survey model was employed for this quantitative research. The participants in the study comprise 306 6th-grade middle school students enrolled in schools affiliated with the Republic of Türkiye Ministry of National Education. The "Social Studies Attitude Scale" and "Social Studies Motivation Scale" were used as data collection tools. The results of the multiple regression analysis revealed that the correlation between motivation and attitude varies depending on their dimensions. Moreover, it was observed that the predictive power of attitude on motivation differed across dimensions.*

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Introduction

MOTIVATION, originating from the Latin word "movere", encompasses concepts such as desire, need, and care. Motivation expresses the inner power one needs and includes feelings associated with completing a task and deriving satisfaction from it (Dörnyei & Ushioda, 2013; Ryan & Deci, 2000). Attitude has its roots in the Latin "Aptus", which refers to an individual's positive or negative reaction toward an object, subject, event, phenomenon, or situation. (İnceoğlu, 2010; Korkut, 1994). An analysis of the definitions of motivation and attitude reveals that both concepts are closely linked to one's feelings, thoughts, and experiences. Initiating and continuing a behavior is associated with motivation (Altun & Yazıcı, 2010; Gürşimşek, 2002). Motivation is a significant stimulus that shapes the emergence and course of behavior. While the stimulus is an essential factor in triggering an individual, internal and extrinsic stimuli are effective in shaping the direction of behavior (Deci & Ryan, 1985).

The process of motivation cannot be fully comprehended without revealing the reasons directing an individual toward a particular behavior, the goals they have established, and the circumstances that enable them to maintain that behavior. Therefore, accurately defining the two dimensions of motivation, namely intrinsic and extrinsic motivations, will enhance our understanding of this process. Intrinsic motivation can be defined as an internal drive originating solely from the individual, assisting to fulfill their personal needs. It also refers to the individual's self-motivation to engage in a task - without any influence of external stimuli- and actively participate in the process to achieve their desired goal. The continuity of intrinsic motivation is an energy hidden within the individual. It can be argued that external factors and rewards eliminate the motivational drive, particularly by creating obstacles to intrinsic motivation (Deci et al., 1999; Ergün, 2011; Zengin & Ulaş, 2021). In contrast to intrinsic motivation, extrinsic motivation refers to an individual's mobilization driven by external influences. It is a phenomenon that occurs when activities that are bound to conclude still have meaning for the individual (Vallerand et al., 1997). In this type of motivation, persistence is maintained through the use of punishments and rewards, and individuals exert effort to attain a particular position. Promotion is a commonly used tool at the beginning of such processes. Since an individual's primary focus is the target reward rather than the action itself, distractions and discouragements can significantly impact this process (Deci et al., 1999; Hoy & Miskel, 2008; Zengin & Ulaş, 2021).

While motivation is an important factor in increasing students' success and interest in a course, it alone is not sufficient to achieve these. The emergence and maintenance of behaviors are related to motivation, as well as attitude. Motivation and attitude are stimulants that are attained later and

cannot be directly observed (Aksoğan & Özdemir, 2022; Zengin & Ulaş, 2021). Learners' motivation to learn is influenced by their attitude toward the subject (Csizér & Dörnyei, 2005). This is why motivation and attitude are interrelated concepts. For instance, individuals who develop a negative attitude toward an event, phenomenon, or object tend to lack interest in it and exhibit low motivation in this respect (Saracaloğlu et al., 2006). Motivation and attitude are the two most important affective skills influencing students' success in a course (Ceylan et al., 2015). The desire to achieve a specific goal is related to motivation, while the experiences gained in the pursuit of that goal shape one's attitude. The high motivation of students for a course is also an indicator of their positive attitudes toward that course (Fidan, 2012). Motivation facilitates learning, helps students maintain a high level of interest and attention in their lessons, and prevents boredom during the learning process, thereby making learning easier. Accordingly, motivation for learning increases the quality of teaching by positively affecting the learning process and the learning environment (Akbaba, 2006; Kelecioğlu, 1992). Regardless of the educational approach and methodology, it is not feasible for an individual who lacks adequate motivation and has not cultivated a positive attitude toward their study to exhibit desirable behavior. If students do not develop a positive attitude toward the education process and lack motivation for it, even successful students may quickly forget the skills and behaviors they have acquired (Zengin & Ulaş, 2021). Motivation plays an important role in the effective educational process; greater motivation can lead to increased success (Özaydınlık & Aykaç, 2013). Considering the impact of motivation on students' learning psychology, it can also affect students' behavior and academic success in various ways (Başıbüyük & Çıkılı, 2002). Given the diverse factors that influence students' motivations, it is crucial to consider these variables during the learning process. Students' specific attitudes are outcomes of their prior experiences. Students' attitudes toward any object, event, phenomenon, or situation are shaped by their experiences and social environment (Kağıtçıbaşı, 1999). Accordingly, it is essential to comprehend the relationship between middle school students' motivation and attitudes. Therefore, determining the predictive power of both variables on each other is of significant importance for enhancing the learning process and learning environment. Consistent with this, other studies have also identified motivation and attitude as significant factors in the learning process and learning environment (Meral, 2013; Tosun & Nalçacı, 2023).

A review of studies related to motivation revealed that motivation facilitates the teaching process and positively affects students' learning aspirations (Arcagök, 2016; Doğan, 2021; Durmaz, 2014; Fırat, 2019; Kulakaç, 2020; Yerlikaya, 2014; Yıldırım, 2013). Many studies reported that attitude has a positive impact on the learning process of students (Akdemir, 2019;

Çağlar, 2020; Çalışkan & Turan, 2010; Çiftçi & Kaya, 2012; Ergin, 2006; Gökkaya & Tural, 2012; Kadıoğlu, 2007; Kadıoğlu-Ateş & Vatansever-Bayraktar, 2020; Kılınç & Dere, 2015; Meral, 2013; Özkal, 2013; Özkal et al., 2004; Öztürk & Baysal, 1999; Pullu & Gömleksiz, 2020; Tay & Akyürek-Tay, 2006; Tosun, 2011; Tuncer & Yılmaz, 2016; Yalman & Çiftçi, 2019; Yılmazer & Demir, 2014). In a prior study, a significant relationship was identified between students' attitudes toward the social studies course and their academic achievement (Tay, Akyürek-Tay, 2006). Similar results have been reported in studies examining both motivation and attitudes toward the social studies course (Tosun & Nalçacı, 2023).

Furthermore, some studies found that students have low motivation and negative perceptions of the social studies course (İlter & Çiğdem, 2014). The negative attitudes and behaviors that students cultivate toward the social studies course have a significant impact on their academic performance and motivation in this field. In particular, the perception that the social studies course heavily relies on memorization appears to be a significant barrier to students' ability to understand and comprehend the content (Coşkun & Samancı, 2012; Tay, 2004). Several limiting factors, including the heavy content of the social studies curriculum, crowded classrooms, and the passivity of students in the class negatively affect students' attitudes and motivation toward the course (Altınışık, 2001). Academic motivation and attitudes play a crucial role in achieving the goals of the social studies course. Students' academic motivation and favorable attitudes toward the social studies course will likewise have an impact on their academic performance in this field. When students exhibit high motivation and maintain a positive attitude toward a course, it is likely to lead to an increase in their academic achievement (Faiz & Karasu-Avcı). Accordingly, it can be argued that the negative attitudes and behaviors developed by students toward the social studies course affect their success in this course. Therefore, motivation and attitude, which are important factors for success in social studies education and are evaluated within the affective domain, constitute the main variables of this study.

Given the importance of the relationship between motivation and attitude, this study investigates the correlation between the motivation and attitudes of 6th-grade middle school students toward the social studies course as well as the predictive role of attitude on motivation. For this purpose, answers to the following questions will be sought:

1. What are the internal consistency (α) values for middle school students' motivation and attitudes toward the social studies course?
2. Is there a statistically significant difference between middle school students' motivation and attitudes toward the social studies course?

3. What is the predictive power of middle school students' attitudes toward the social studies course on their motivation (intrinsic motivation, care, and extrinsic motivation)?

Method

Since this quantitative study examines whether middle school students' motivation and attitude towards social studies courses predict each other, a correlation survey model was used. The correlation survey model is a descriptive statistical research approach used to identify the relationships between two or more variables and to determine the direction and strength of these relationships. This method is used to examine the characteristics and structure of past and existing phenomena (Creswell, 2012; Fraenkel et al., 2012). A correlation survey model seeks to determine a past or current situation in its natural context. In other words, correlation survey is a research approach where the relationship between two or more variables is examined without making any alterations or interventions (Karasar, 2009).

Study Group

The participants in the study comprise 306 6th-grade middle school students enrolled in schools affiliated with the Bilecik (Türkiye) Provincial Directorate of National Education. The participants were selected using convenience sampling. Since the students in this sample are sixth graders, the mean age of the participants was approximately 12 years.

Data Collection Tools

The "Social Studies Course Motivation Scale" and the "Social Studies Course Attitude Scale" were used as the data collection tools.

Social Studies Course Motivation Scale

The "Social Studies Course Motivation Scale", developed by Gömleksiz and Kan (2012) for middle school students, was used to measure students' motivation in the social studies course. This scale comprises 23 items divided into three dimensions namely, 'intrinsic motivation,' 'extrinsic motivation,' and 'care'. Participants responded using a 5-point Likert-type scale, with response options ranging from "strongly agree" to "strongly disagree". The Cronbach's Alpha reliability index for the total scale was found to be 0.792. The reliability of the dimensions was calculated as follows: 0.802 for intrinsic motivation; 0.745 for extrinsic motivation, and 0.826 for the care dimensions. The scale explained 41 percent of the total variance.

Social Studies Course Attitude Scale

The "Social Studies Course Attitude Scale" developed by Gömleksiz and Kan (2013) was employed to measure students' attitudes toward the social studies course. The social studies course attitude scale consists of 29 items divided into five dimensions namely, 'affection', 'benefit', 'care', 'desire', and 'trust'. Participants answered using a 5-point Likert-type scale (strongly agree, agree, neutral, disagree, and strongly disagree). The Cronbach's Alpha of the total scale was calculated as 0.61. Additionally, the Guttman Split Half index for the scale was found to be 0.71, while equal-length and non-equal-length Spearman-Brown values were determined as 0.71. The scale explained 55.95 percent of the total variance. The Affection dimension had a reliability index of 0.87 and explained 35.92 percent of the variance. The benefit dimension had a reliability index of 0.88 and explained 8.94 percent of the variance. The reliability index for the care dimension was found to be 0.77, accounting for 4.03 percent of the total explained variation. The reliability index for the desire dimension was calculated as 0.76, accounting for 3.58 percent of the total explained variation. Finally, the trust dimension had a reliability index of 0.74 and explained 3.49 percent of the variance.

Data Analysis

The data collection tools of this study are the "Social Studies Course Motivation Scale" and the "Social Studies Course Attitude Scale". Prior to the main analyses, preliminary assessments were carried out to assess whether the data were normally distributed. Primarily, it is checked whether the data sets showed normal distribution or not to analyze the data. Tabachnick and Fidell (2013) highlight that data are considered normally distributed if skewness and kurtosis values fall within the range of ±1.50. For both scales, the skewness and kurtosis values were found to be within the range of ±1.50, indicating that the data were normally distributed. Assuming that the data obtained from both scales (The social studies course motivation scale and social studies course attitude scale) showed a normal distribution, the data were examined using multiple regression analysis. A series of multiple regression analyses were applied to examine the predictive role of attitude (and its dimensions) toward the social studies course on motivation in this course. For interpreting effect sizes, the thresholds proposed by Cohen (1988) were followed and effect sizes were classified as small (0.01 – 0.059), medium (0.06 – 0.139), or large (≥ 0.14). All analyses were conducted using SPSS (Statistical Package for the Social Sciences, version 25).

Table 1. Descriptive Statistic.

Variables	N	Mean	SS	Skew	Kurtosis	α
Intrinsic M.	306	18.64	6.68	0.869	0.830	0.84
Care	306	32.08	5.61	-0.977	1.200	0.75
Extrinsic M.	306	18.27	5.24	-0.123	-0.372	0.75
Affection	306	26.78	8.73	0.352	-0.183	0.88
Benefit	306	24.20	5.43	-1.247	1.391	0.88
Interest	306	10.51	4.38	1.039	1.099	0.85
Desire	306	14.06	3.74	-0.588	-0.238	0.76
Trust	306	15.01	3.66	-0.718	0.222	0.76

Note: M. = Motivation

Findings

First, descriptive statistics are presented, followed by exploratory analyses to assess scale characteristics, assumptions of normal distribution, and relationships among the variables. These preliminary analyses included examining skewness and kurtosis values as presented in **Table 1**. According to the results, the skewness and kurtosis scores were within the suggested range of ±1.50, as recommended by Tabachnick and Fidell (2013). These results confirmed the assumption of normal distribution. Furthermore, the internal consistency (α) values of the variables ranged from 0.75 to 0.88, indicating that the measures have high reliability.

After examining descriptive statistics, a Pearson correlation analysis was performed to examine the correlations between the variables. The results revealed varying degrees of relationships between the variables, ranging from weak to strong. Regarding the motivation dimensions, intrinsic motivation was found to be positively correlated with extrinsic motivation ($r = 0.35$, $p < 0.01$) and negatively correlated with care ($r = -0.59$, $p < 0.01$). However, no significant correlation was observed between care and extrinsic motivation ($p > 0.05$). On the other hand, the examination of attitude dimensions indicated that affection positively correlated with interest ($r = 0.35$, $p < 0.01$), while it exhibited negative correlations with the other dimensions: benefit ($r = -0.59$, $p < 0.01$), desire ($r = -0.57$, $p < 0.01$), and trust ($r = -0.44$, $p < 0.01$). Similar to affection, interest also showed negative relationships with other attitude dimensions, namely benefit, desire, and trust. On the contrary, the benefit, desire, and trust dimensions exhibited positive correlations among themselves (**Table 2**). Finally, the relationships between the dimensions of motivation and attitude were examined. Intrinsic motivation had positive

Table 2. Correlation Findings Among the Variables.

	1	2	3	4	5	6	7	8
1. Intrinsic M.	-							
2. Care	-0.59**	-						
3. Extrinsic M.	0.35**	-0.11	-					
4. Affection	0.68**	-0.41**	0.33**	-				
5. Benefit	-0.54**	0.56**	-0.07	-0.59**	-			
6. Interest	0.67**	-0.45**	0.24**	0.81**	-0.65**	-		
7. Desire	-0.47**	0.51**	-0.06	-0.57**	0.72**	-0.62**	-	
8. Trust	-0.42**	0.49**	-0.05	-0.44**	0.65**	-0.43**	0.61**	-

Note: M. = Motivation

correlations with affection ($r = 0.68$, $p < 0.01$) and Interest ($r = 0.67$, $p < 0.01$), but negative correlations with benefit ($r = -0.54$, $p < 0.01$), desire ($r = -0.47$, $p < 0.01$) and trust ($r = -0.42$, $p < 0.01$). A similar relationship pattern was observed between extrinsic motivation and attitude dimensions. On the other hand, extrinsic motivation was found to be significantly correlated with affection ($r = 0.33$, $p < 0.01$) and interest ($r = 0.24$, $p < 0.01$), but exhibited non-significant correlations with other attitude dimensions ($p > 0.05$). Furthermore, care motivation displayed positive correlations with benefit ($r = 0.56$, $p < 0.01$), desire ($r = 0.51$, $p < 0.01$), and trust ($r = 0.49$, $p < 0.01$), but negative correlations with affection ($r = -0.41$, $p < 0.01$) and interest ($r = -0.45$, $p < 0.01$). All correlational findings are listed in **Table 2**.

The Results of the Predictive Analysis

To examine the predictive role of students' attitudes toward the social studies course on their motivation, three separate multiple regression analyses were conducted for each motivation dimension. Along with the correlation values between the variables, Variance Inflation Factor (VIF) values were examined and no multicollinearity issues were observed. Additionally, the normal distribution of the variables indicated that the assumptions of the regression analysis were confirmed. Initially, the relationships between intrinsic motivation and attitude dimensions were analyzed. The results showed a significant relationship ($F_{(5,300)} = 65.02$, $p = 0.000$) between intrinsic motivation ($R = 0.72$, $R^2 = 0.50$) and attitude dimensions. According to the standardized regression coefficients, while affection ($\beta = 0.37$, $p = 0.000$) and interest ($\beta = 0.30$, $p = 0.000$) emerged as significant predictors of intrinsic motivation, other attitude dimensions did not significantly predict intrinsic motivation ($p > 0.05$). The attitude dimensions collectively accounted for 52%

Table 3. The Results of the Multiple Regression Analysis.

Independent Variable	Dependent Variable	B	SE	β	t	p
Intrinsic M.	Constant	10.53	2.54	-	4.13	0.000
	Affection	0.28	0.05	0.37	5.24	0.000
	Benefit	-0.12	0.08	-0.10	-1.40	0.160
	Interest	0.46	0.11	0.30	4.20	0.000
	Desire	0.10	0.11	0.05	0.87	0.385
	Trust	-0.19	0.10	-0.10	-1.85	0.065
	$R = 0.72$, $R^2 = 0.50$, $F = 65.02$, $p = 0.000$					
Care	Constant	19.88	2.47	-	8.04	0.000
	Affection	-0.010	0.05	-0.01	-0.17	0.860
	Benefit	0.28	0.08	0.27	3.42	0.001
	Interest	-0.13	0.11	-0.10	-1.14	0.253
	Desire	0.22	0.11	0.15	2.03	0.042
	Trust	0.27	0.10	0.18	2.76	0.006
	$R = 0.60$, $R^2 = 0.36$, $F = 33.69$, $p = 0.000$					
Extrinsic M.	Constant	5.17	2,676	-	1.935	0.054
	Affection	0.27	0.056	0.456	4.879	0.000
	Benefit	0.12	0.087	0.125	1.391	0.165
	Interest	0.03	0.120	0.025	0.246	0.806
	Desire	0.17	0.117	0.128	1,529	0.127
	Trust	0.00	0.105	0.000	-0.002	0.998
	$R = 0.37$, $R^2 = 0.14$, $F = 9.78$, $p = 0.000$					

Note: M. = Motivation

of the variation in intrinsic motivation. The findings of the multiple regression analysis are given in **Table 3**.

Secondly, the predictive role of attitude dimensions on care motivation was examined. The multiple regression analysis results indicated that attitude dimensions collectively displayed a significant relationship with care motivation ($R = 0.60$, $R^2 = 0.36$) ($F_{(5,300)} = 33.69$, $p = 0.000$). According to the standardized regression coefficients, while benefit ($\beta = 0.27$, $p = 0.001$), desire ($\beta = 0.15$, $p = 0.042$) and trust ($\beta = 0.18$, $p = 0.006$) were identified as significant predictors of care motivation, affection, and interest dimensions did not demonstrate statistical significance as predictors ($p > 0.05$). The attitude dimensions collectively accounted for 36% of the variation in care motivation (**Table 3**).

Finally, extrinsic motivation was included as a dependent variable in the multiple regression analysis. According to the analysis results, attitude dimensions collectively exhibited a significant correlation with extrinsic motivation ($R = 0.37$, $R^2 = 0.14$) ($F_{(5,300)} = 9.78$, $p = 0.000$). The standardized

regression coefficients indicated that only the affection dimension ($\beta = 0.46$, $p = 0.000$) was a significant predictor of extrinsic motivation, while the other attitude dimensions did not exhibit statistical significance as predictors of extrinsic motivation ($p > 0.05$). The attitude dimensions collectively accounted for 14% of the variation in extrinsic motivation (**Table 3**).

Conclusion and Discussion

Motivation is the most vital affective element that can enhance the learning process and create a productive student environment (Narmanlı, 2019). Motivation is needed to achieve desired learning outcomes and academic success for students (Keskin, 2008). Therefore, providing motivation can enhance students' interest in a course and improve the efficiency of the learning process (Aydemir, 2012). Students' success and productivity in courses largely depend on motivation (Tahiroğlu, 2015). The acquisition of desired student behaviors and their subsequent academic success can be explained by motivation (Polat, 2019). The emergence and maintenance of desired behaviors are correlated with both attitude and motivation (Aksoğan & Özdemir, 2022). The key findings of the current study can be summarized as follows.

Among the motivation dimensions, intrinsic motivation and extrinsic motivation displayed a positive relationship. However, intrinsic motivation had a negative relationship with the care motivation dimension. Besides, no significant difference was observed between the care and extrinsic motivation dimensions. On the other hand, a significant positive relationship was identified between the affection and interest dimensions of attitude. Furthermore, the affection dimension showed a negative correlation with other dimensions, namely benefit, desire, and trust. The care dimension also displayed a positive correlation with the affection dimension.

Moreover, the affection and interest dimensions showed positive significant correlations with intrinsic motivation. On the contrary, the benefit, desire, and trust dimensions exhibited negative correlations with intrinsic motivation. Similar results were obtained between extrinsic motivation and the attitude dimensions. Accordingly, the affection and interest dimensions showed significant relationships with extrinsic motivation, whereas other dimensions of attitude did not exhibit a significant correlation with extrinsic motivation. It was observed that while care motivation had a negative relationship with the affection and interest dimensions of attitude, it exhibited positive correlations with the benefit, desire, and trust dimensions.

Significant relationships were identified between attitude dimensions and intrinsic motivation. Additionally, the affection and interest dimensions were significant predictors of intrinsic motivation, whereas other attitude dimensions did not significantly predict intrinsic motivation. Therefore, it

was observed that the attitude dimensions accounted for a substantial portion of the variance in intrinsic motivation. Furthermore, significant relationships were observed between the attitude dimensions and care motivation. The care dimension of motivation predicted benefit, desire, and trust dimensions of attitude. Moreover, the care dimension showed no significant relationships with the affection and interest dimensions, and it did not predict them. In conclusion, the affection and interest dimensions significantly predicted the variance in intrinsic motivation.

The attitude dimensions collectively showed a significant correlation with extrinsic motivation. However, only the affection dimension of attitude significantly predicted extrinsic motivation. Other attitude dimensions did not significantly explain the variance in extrinsic motivation. Overall, it was concluded that the relationship between motivation and attitude varied depending on their respective dimensions, and the predictive power of attitude on motivation also varied according to their dimensions.

A literature survey revealed that only a few studies in the field of social studies share a similar focus with the current study (Çağlar, 2022; Faiz & Karasu- Avcı, 2020; Fırat, 2019). Çağlar (2022) observed a significant relationship between middle school students' attitudes toward the social studies course and their motivation in this course. This significant relationship reported by Çağlar (2022) is consistent with the results of our study. In the current study, on the other hand, it was observed that the significant differences between motivation and attitude dimensions varied depending on their respective dimensions, leading to changes in the observed effect sizes. Furthermore, Fırat (2019) analyzed the relationship between motivation and attitude. He observed a significant relationship between the motivation and attitude levels of middle school students toward the social studies course. This finding further supports the significant difference between certain dimensions of motivation and attitude observed in the present study. However, both Çağlar (2022) and Fırat (2019) examined motivation and attitude separately, without exploring their predictive roles on each other. On the contrary, the current study focused on the relationship between middle school students' motivation and attitudes toward the social studies course and revealed the predictive power of attitude toward the social studies course on motivation. In this regard, the present study differs from Çağlar (2022) and Fırat (2019). In other words, what distinguishes the present study from previous research is the discovery that the relationship between motivation and attitude varies depending on their dimensions, and the predictive role of attitude on motivation differs across these dimensions.

Faiz and Karasu-Avcı (2020) reported a positive correlation between middle school students' attitudes toward the social studies course and their motivation. In their study, a strong positive relationship was identified between certain dimensions of motivation (between intrinsic motivation and

reflected regulation, as well as between reflected regulation and external regulation), whereas weaker correlations were observed between some dimensions (motivation toward knowledge and amotivation). In the present study, intrinsic motivation showed significant positive correlations with the affection and interest dimensions but exhibited negative correlations with benefit, desire, and trust.

In addition to these limited number of studies on social studies, research in other fields has also indicated a relationship between motivation and attitude. For example, Erdem and Gözüküçük (2013) attributed the academic success in the Turkish course to the high motivation and attitudes of the students toward this course. Fidan and Eren (2017) reported that higher intrinsic motivation among students increases the likelihood of positive attitudes, while lower motivation increases the likelihood of negative attitudes. Furthermore, according to Kodaz (2016), attitude has a significant positive impact on intrinsic motivation. The findings reported in Kodaz's (2016) study concerning the correlation between attitude and motivation align with those of the current study. Also, several other studies reported significant moderate positive relationships between motivation and attitudes depending on their dimensions (Akhmadjonov, 2019; İnalöz & Yılmaz, 2023).

Limitations and Recommendations for Future Research

This study had several limitations. Factors such as the small sample size and limited variables (e.g., grade level, socioeconomic status, gender) should be taken into account when evaluating the study's results and in future research.

Many studies have examined whether motivation and attitude scores significantly vary by age and gender. However, no significant differences were observed for these variables within the groups examined in the samples of these studies. For example, studies examining the motivation levels of middle school students toward the social studies course reported that there was no significant gender-based difference (Çağlar, 2022; Demir, 2010; Ergin 2006; Fırat, 2019; Özkal, 2013; Tosun & Nalçacı, 2023). Additionally, many studies revealed that students' attitudes toward the social studies course do not differ significantly according to gender (Güven, 2008; Öztürk & Baysal, 1999; Tay & Akyürek-Tay, 2006; Yüce, 2008). In studies examining secondary school students' attitudes and motivation toward the social studies course, the gender variable was found not to significantly affect their scores. In the current study, it was considered that students' motivation and attitudes toward the social studies course do not differ by gender, and the relationship between students' motivation and attitude scores toward the social studies course and the predictive role of these variables were examined.

Studies examining middle school students' attitudes or motivations toward the social studies course based on grade level found that scores varied across grade levels (Çağlar, 2022; Demir, 2010; Doğan 2021; Şimşek & Demir 2012; Yıldırım 2013; Yüce, 2008). These studies suggested that grade-level-related differences in attitudes and motivations could be attributed to variations in lesson content and developmental stages (concrete-abstract periods) (Çağlar, 2022; Yüce, 2008). Many studies on middle school students' attitudes or motivation toward the social studies course focused on a single grade level (Aktepe et al., 2014; Çelikkaya & Ünal 2009; Sarıtepeci & Çakır 2014; Tosun & Nalçacı, 2023; Zengin & Ulaş, 2021). The current study was also limited to a single grade level (6th grade) in accordance with its objectives. These literature findings highlight the need for studies examining factors that may influence grade-level-related results. Therefore, considering the findings reported in the literature related to the grade level highlight the same result, it is recommended to conduct studies that examine the factors contributing to variations in students' attitudes and motivation toward the social studies course across different grade levels. For example, considering that the results may differ by developmental periods (concrete-abstract) (Çağlar, 2022), it is recommended to conduct studies at both the lowest (4th) and highest (7th) grade levels where the social studies course is taught in Türkiye.

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REVIEW

Practical Validation of the ICAP Theory in China: Holistic Module Learning in the Shandong 271 Education Group

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***Abstract**: ICAP is one of the most impactful theories in the international community of cognitive and learning science. ICAP research focuses on active learning and student engagement with high applicability and guiding value. In the context of the reform of curricula and instruction in China, this article seeks to pinpoint the commonalities between the ICAP theory and the rationale underlying the holistic module learning model prevalent in schools at Shandong 217 Education Group to verify the practicality of applying the theory to Chinese education.*

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THE transformation of the learning paradigm is the focus of as well as the fundamental challenge to the recent decade's curricular and instructional reform in China and has garnered wide attention from Chinese educators and administrators. At the 2017's inaugural meeting of the "Teacher Professional Development Research Center" of the Chinese Education Society, Gu (2017) stressed that the primary issue with Chinese education was to transition from the emphasis on teaching to the focus on learning, to recognize students' agency in the classroom, and to make learning a student-centered process. To do so, it is necessary to encourage "active learning" in students through autonomous, exploratory, and engaging activities.

September 28, 2023, the Yidan Prize, known as the highest education accolade on earth, announced that its Prize for Education Research 2023 was awarded to Professor Michelene T.H. Chi from Arizona State University. According to Andreas Schleicher, head of the Yidan Prize for Education Research judging panel and Director for Education and Skills at the Organization for Economic Co-operation and Development, Chi's research is not simply an empirical classification of observational or existing research but rather an endeavor grounded on a solid theoretical foundation that integrates the main research achievements in the field of cognitive science and bridges the discrepancies in the literature. Her most significant contribution to educational research is the development of ICAP theory, a scientific theory of how students learn. She has organized different approaches to "active learning" into a simple yet widely applicable framework and is passionate about ensuring that this theory changes educational practice across the board (Liang, 2023).

The ICAP Theory

Chi (2009) proposed a taxonomy that aims to differentiate *active, constructive, and interactive* learning activities on the basis of learners' overt behaviors and levels of engagement. A hypothesis was generated from this taxonomy that *interactive* activities are most likely to be better than *constructive* activities, which in turn might be better than *active* activities, which are better than being *passive*. Here, overt activities refer to externally observable activities such as note-taking, concept mapping, and self-explaining (Chi et al., 1989). Learning engagement refers to the underlying cognitive processes for the overt activities that mediate learning in different ways (Chi, 2009).

After years of exploration, Chi and Wylie (2014) officially advanced the theory as the "ICAP Framework." In April 2017, Sheng, Ding, and Teng (2017) from Zhejiang University's School of Education introduced the ICAP theory to the Chinese educational community and underscored the value of this framework and its practical significance for teaching in China. Sheng

and Ding (2018) argued that the ICAP theory provided concrete, applicable recommendations on student engagement with learning materials in learning settings and could serve as a guide in creating teaching designs for various disciplines.

ICAP Hypothesis

According to the ICAP framework, student engagement behaviors can be categorized and differentiated into four modes: interactive, constructive, active, and passive. The ICAP hypothesis predicts that as activities move from passive to active to constructive to interactive, students undergo different knowledge-change processes, and, as a result, learning will increase (Chi & Wylie, 2014).

Passive Mode of Engagement. In the ICAP framework, the passive mode of engagement is defined as "learners being oriented toward and receiving information from the instructional materials without overtly doing anything else related to learning" (Chi & Wylie, 2014, p. 221). Paying attention is the key element in this level of engagement. Examples of paying attention include reading a text silently, watching a video without doing anything else, or listening to a lecture without taking notes.

Active Mode of Engagement. Learners' engagement with instructional materials can be labelled as active if some form of overt motoric behavior or physical manipulation is conducted. Overtly active behaviors include repeating or rehearsing, copying solution steps, taking verbatim notes, underlining or highlighting, summarizing by copy-and-delete, and so forth (Chi et al., 1994). Such behaviors cause focused attention while manipulating, which distinguishes them from overt activities that are carried out mindlessly (Chi & Wylie, 2014).

Constructive Mode of Engagement. Under the ICAP taxonomy, constructive behaviors are those with which learners generate or produce additional products beyond what is provided in the learning materials (Chi & Wylie, 2014). Examples of being constructive include drawing concept maps, asking questions, self-explaining, integrating across texts, taking notes in one's own words, and more. Constructive engagement emphasizes the generation of new knowledge during the learning process, requiring students to engage in information processing and inventive representation, develop a deeper understanding of knowledge, and ultimately achieve knowledge transfer (Sheng et al., 2017). Due to the assumption that there is a hierarchy in the taxonomy, i.e., a higher mode subsuming a lower mode, constructive behaviors require learners to be active or manipulative. However, being generative is the paramount characteristic of a constructive mode of engagement. In

other words, the outputs of generative behaviors should contain new ideas that go beyond the information given to distinguish them from the behaviors that are merely active or manipulative (Chi & Wylie, 2014).

Interactive Mode of Engagement. In the ICAP context, interactive engagement refers to a learner's interactions with a partner who can be a peer, teacher, parent, or computer agent, often through dialogues, which should meet two criteria: (i) both partners' utterances must be primarily constructive; and (ii) a sufficient degree of turn-taking must occur. Examples of this category of engagement include defending and arguing a position in dyads or small groups, asking and answering comprehension questions with a partner, debating with a peer about justifications, and discussing similarities and differences (Chi & Wylie, 2014). In their research on dialog patterns in peer collaboration, Chi and Menekse (2015) came up with five distinct dialogue patterns: passive-active, passive-constructive, active-active, active-constructive, and constructive-constructive, based on each partner's possible discourse contribution being passive, active, or constructive, and identified constructive-constructive as the dialogue pattern that promotes the greatest learning.

There are four main types of knowledge-change processes that the ICAP framework says underlie the four modes of engagement. These are storing, integrating, inferring, and co-inferring. It also assumes that different knowledge-change processes cause different changes in one's knowledge, resulting in different cognitive outcomes, such as being able to recall, apply, transfer, and co-create. As a result, a hypothesized order of learning outcomes is proposed: interactive > constructive > active > passive (ICAP). In sum, the ICAP hypothesis predicts that as activities move from passive to active to constructive to interactive, students undergo different knowledge-change processes, reaching different levels of cognitive outcomes, and, correspondingly, learning will increase (Chi & Wylie, 2014). It is noteworthy that the term active in ICAP is a label referring to one mode of engagement, whereas the term "active" in active learning is a broad term referring to all three modes (active, constructive, and interactive) of cognitive engagement (Chi et al., 2018).

Empirical Support for the ICAP Theory

Because engineering education did not have a way to group active learning methods used in schools, Menekse et al. (2013) did research to test the ICAP hypothesis by looking at how well interactive, constructive, active, and passive learning activities worked in materials science and engineering classes. Two studies were carried out to determine how and to what degree differentiated activities affected student learning outcomes; student knowledge and

understanding of materials science and engineering concepts were measured. The two studies' results showed that the ICAP hypothesis was right on the money. They also suggested that the ICAP taxonomy of overt learning activities could help researchers, instructional designers, and teachers come up with activities that are right for their research or lessons.

Chi et al. (2018) undertook a 5-year project that attempted to translate the ICAP theory into a theory of instruction. Research findings showed that although teachers had minimal success in designing constructive and interactive activities, students nevertheless learned significantly more through constructive than active activities. In addition, the study helped Chi and her associates ascertain the challenges they needed to overcome in their future ICAP research, such as developing methods to educate teachers to understand and convey to students what effective collaborative dialog patterns are and how to carry out such collaborative interactions.

The ICAP taxonomy of learning activities can serve as a tool to judge the effects of differential learning behaviors on students' learning outcomes based on the quality of learning activity design and the level of learning engagement (Chen et al., 2019). This overt-behavior-based cognitive engagement theory provides operational definitions for students' cognitive processes, facilitating its application in diverse learning settings (Sheng & Ding, 2018). Frontline teachers and instructional designers can use the ICAP framework to observe and analyze the modes of engagement behaviors of learners to identify problems with learning activity design, with the purpose of maximizing students' in-class engagement and interaction as well as enhancing the outcomes of learning activities (Sheng et al., 2017).

Holistic Module Learning in Shandong 271 Education Group

Shandong 271 Education Group, a private education group, runs 15 schools, including Shandong Changle No.2 Middle School, Weifang Experimental Middle School, Weifang Kuiwen Experimental Middle School, Weifang Xiashan Experimental Middle School, Weifang Meijia Experimental School, Weifang Xiashan Bilingual Primary School, Weifang Hansheng International School, the Middle School Affiliated to Yunnan Agricultural University, Yunnan Changle Experimental Middle School, Kunming Xingzhi Middle School, Nanjing Yutong Experimental School, Huai'an Diyishan Middle School, Binzhou Xingzhi Middle School, Jining Haida Xingzhi School, and Dong'a Nanhu Xingzhi School. In total, there are over 60,000 teachers and students in this education group (Zhao, 2019). The holistic module learning model was formed in the instructional reform of basic education in China. Numerous successful implementation cases have emerged, among which

Shandong 271 Education Group's practice is the most exemplary. The model has been well recognized as an effective instructional approach to encouraging active learning in students (Tao, 2023).

Definition of Holistic Module Learning

Holistic module learning is a student-centered teaching model that uses major concepts to re-integrate the learning materials and emphasizes the autonomy and integrity of learning. It facilitates students' mastery of fundamental theories, logical structure, and application value of subject knowledge and helps cultivate students' thinking ability through a comprehensive cognitive process involving self-directed study, dialogue, criticism, application, and generation (Zhao, 2022a). Holistic module learning is structured with modules rather than prescribed textbook units. To deploy modules for a course, teachers must first identify pivotal instructional objectives stipulated in the National Course Standards, establish major concepts based on these objectives, and then organize relevant learning materials into a relatively independent cluster (Zhang, 2023).

A Standardized Procedure for Holistic Module Learning

A standard classroom procedure for holistic module learning typically includes four stages: overall perception, inquiry and construction, application and transfer, and reconstruction and expansion.

Overall perception. Profound education results from the compelling experiences of students. Teachers should provide or create real-life situations for learning content so that students can truly experience the context of learning activities and be self-motivated to go for further inquiry. Learning objectives and tasks are designed based on the major concepts of the module in this first stage.

Inquiry and construction. Through self-directed and cooperative learning, students identify the knowledge, methods, and skills that should be acquired in the current module. They independently build the essential connections between knowledge points and skills. On that basis, students explore the logic behind knowledge and design the inquiry task.

Application and transfer. The application of knowledge and skills should be related to the needs of reality, and learning tasks should be designed to solve practical problems. In fulfilling tasks, students constantly review prior lessons and renew understanding, methods, and skills to generate new ones.

They also exchange ideas on newly generated knowledge, methods, and skills and apply them to new situations in social life to solve new problems. Such cycles of understanding and generation can continuously engender deeper insights into major concepts of the subject.

Reconstruction and expansion. Focusing on the major concepts in the module, students recall the learning process, check on the achievement of learning objectives, and summarize problem-solving methods. By examining the fulfilled tasks, the solved problems, and the new gains, students reconstruct their knowledge structure, build mind maps, and optimize learning methods for all subjects (Zhao, 2022b).

Validation of the ICAP Hypothesis by Holistic Module Learning

Educators with schools in 271 Education Group spot the compatibility between the holistic module learning model and the ICAP framework as their understanding of the theory advances.

Similarities between the Underlying Principles of Holistic Module Learning and the ICAP Theory

Emphasizing Students' Agency in the Classroom

According to the ICAP theory, engagement means capacity: as students' cognitive engagement advances from passive to active, constructive, and interactive, their thinking capacities also improve with the strengthening of their agency, and as a result, their learning outputs increase correspondingly (Sheng et al., 2017). The ICAP framework is therefore learner-centered in that it delineates learning outcomes as a function of the mode of engagement activities undertaken by the learners. Likewise, holistic module learning is a student-centered instructional paradigm, placing a premium on "cognitive internalization" and "generation and construction." Active learning strategies such as self-directed study, collaborative group learning, and inquiry-based learning have been heavily employed in holistic module learning. Task-driven learning, situational experience, autonomous inquiry, and promotional transfer are its main features. The model aims to foster the internal motivation for a student to learn rather than being forced to study (Gao, 2018).

Advocating Structured Learning

Four types of engagement behaviors are mapped to different knowledge-change processes in the ICAP framework. These are storing information separately, activating relevant prior knowledge, integrating new information with prior knowledge, and drawing conclusions from it. Different knowledge-change processes elicit varied changes in the learner's knowledge, resulting in different cognitive outcomes, such as the abilities to recall, apply, transfer, and co-create (Chi & Wylie, 2014). The primary purpose of the holistic module learning model is to overcome the fragmented way of learning in the traditional instruction paradigm. It advocates that teachers and students should build a systematic and holistic view of knowledge for all subjects. In this learning model, students use major concepts to integrate separate knowledge, skills, and methods to obtain a persistent and transferable understanding of knowledge (Zhao, 2022b). A switch from fragmental to structured learning takes place, enhancing students' learning efficiency and effectiveness and providing a foundation for student active learning (Zhou, 2022).

Recognizing the Hierarchical Nature of Cognitive Engagement

There is a hierarchy in the ICAP taxonomy, so a higher mode of engagement subsumes a lower one. That is, interactive behaviors subsume constructive behaviors, and constructive behaviors subsume active behaviors. Accordingly, the knowledge-change processes for each higher mode subsume the processes for the lower mode (Chi & Wylie, 2014). Constructive learning behaviors occur when personal judgments and insights are generated on the basis of activated prior knowledge; constructive engagement is upgraded to interactive engagement when the peer's or peers' ideas are integrated. In this process, shallower learning is developed into deeper learning (Sheng et al., 2017). Such cognitive regularity also underlies the process of holistic module learning. "Overall perception" is the preliminary construction of basic knowledge; "inquiry and construction" is the second stage of construction based on the initial one; "application and transfer" is the third phase of knowledge construction built on the preceding ones; and "reconstruction and expansion" is the fourth stage, involving higher-order thinking skills such as inference (Zhang & Wang, 2022).

The Implementation Strategies of Holistic Module Learning Reinforce the ICAP Hypothesis

Ensuring Student in-class Engagement through Well-designed Learning Protocols

As the ICAP theory predicts different levels of learning as a function of different modes of engagement across various activities (Chi et al., 2018), schools with 271 Education Group place special emphasis on activity design in creating learning protocols to maximize student cognitive engagement. Well-crafted learning protocols play a vital role in the successful implementation of holistic module learning. These schools reorganize course contents by developing holistic module learning protocols, also referred to as "271 learning protocols." Holistic module learning protocols are systematic, structured, and smart instructional plans that support student learning. 271 learning protocols adhere to the following principles that guide the design of student learning activities (Liu, 2022):

Boosting Students' Self-motivation to Study. The critical criterion of activity design is self-driven, i.e., establishing the internal motivation to learn rather than being forced to study. An ideal learning task can turn monotonous, unfamiliar knowledge into appealing, challenging activities and pique students' interest in learning. Students' quests for additional knowledge and skills increase after they complete the work.

Pointing to the Cultivation of Student Key Competencies. Well-designed activities are beneficial for fostering students' core abilities and essential characters. In the process of completing learning activities, students naturally build their own knowledge structure, improve learning methods and skills, and, as a result, develop key competencies.

Developing Higher-Order Thinking Skills in Students. Higher-order thinking refers to intellectual ability based on higher levels of cognitive processing. Higher-order thinking skills include synthesizing, reasoning, comprehending, applying, evaluating, and more. In 271 learning protocols, learning activities are of a sufficient level of difficulty and challenge to elicit significant thought and careful execution to encourage student higher-order thinking.

Posing Open Questions. Open questions are questions that cannot be addressed with "yes" or "no" answers or ready solutions from textbooks. Activities with open, heuristic questions can instigate deeper thinking about prior knowledge and curiosity about new areas to be explored in students.

In addition, evaluation in holistic module learning is a combination of formative and summative assessment. Assessment scales and quizzes are embedded in learning activities. Teachers judge student learning outcomes by the

results of the two forms of assessment and make necessary adjustments and modifications for their instructional plans (Liu, 2022).

Optimizing Learning Outcomes through Collaborative Group Learning

The ICAP theory introduces the idea that different modes of interacting with the learning materials lead to different levels of learning outcomes, with the collaborative/interactive mode having the potential to produce the deepest learning among the four modes of engagement activities (Chi et al., 2018). According to ICAP's definition of interactive engagement, being interactive requires that each person in the group contribute constructively. Dialogues are truly interactive only if each speaker's expressions generate some knowledge beyond what was presented in the original learning materials and beyond what the partner has said. Thus, all group members need to be constructive. In addition, a dialogue must have a sufficient frequency of turn-taking to meet the definition of interactive. It is not very interactive when one partner dominates and generates most of the substantive contributions and the other partner merely agrees or contributes with passive responses (Chi & Wylie, 2014).

Collaborative group learning is a pivotal strategy for implementing holistic module learning. In schools with 271 Education Groups, the study group is the fundamental building block of classroom structure. There are several measures in place to guarantee high-quality, productive interaction taking place in group studies.

- The organization of study groups follows the principles of homogeneity between groups and heterogeneity within the group, which means each group consists of members of different academic levels, thinking dispositions, learning styles, interests, genders, and personalities. Generally, a study group is made up of four students. Both individuals and the group have the option to determine the composition of the group. In addition, there is a specialty study group for each subject, composed by one student from each study group. As a result, everyone in the class has a specialty study group to join. They are assistants for teachers and academic leaders for group members in their respective subjects. Before class, the specialty study group leader organizes discussions on learning materials and learning activities for the current module to formulate the learning plan, objectives, and strategies, and then the specialty study group members transmit the agreed plan to each study group. In class, self-study, cooperation, and inquiry are conducted alternately. Everyone has the

equal opportunity to represent their ideas, and finally the solution to a specific question or issue is reached within the group (Zhao, 2022b).

- Nevertheless, group activities in class can be disorderly and ineffective; students often spend time chatting about things irrelevant to the lesson. Such group work wastes classroom learning time, and students fail to achieve the objective of cooperative learning. To address the issue of classroom order and engage students in real interaction, detailed specifications for in-class activities are devised in learning protocols. Teachers and students use dialogues and discussions to carry out inquiry cooperatively according to the prescribed question and activity chain to ensure maximal amounts of interaction between group members and between students and teachers (Wang, 2022).
- All collaborative learning is goal-oriented. Classroom activities are organized to solve specific problems, avoid aimless extension, and guarantee the accomplishment of the teaching plan. The evaluation of academic achievement is based on group performance. Each student's academic results are connected to the combined achievements of all group members. With this evaluation system, students are motivated to make optimal contributions to intra-group interaction (Hua, 2023).

Conclusion

ICAP is a comprehensive theoretical framework for active learning and a student-centered theory, as it focuses on studying how students' engagement with instructional materials is related to their learning products. The ICAP hypothesis has been validated through many classroom and laboratory studies and thus can serve as a guide for lesson plans.

The ICAP theory provides a novel lens for the reform of curricula and instruction in Chinese education. At present, there is a paucity of ICAP research, particularly empirical studies, in China. Shandong 271 Education Group's practice of holistic module learning can serve as evidence supporting the ICAP theory. At the same time, it is noteworthy that there is also insufficient empirical research on holistic module learning, despite the instructional model having been implemented in schools affiliated with 271 Education Group for many years and having generated significant achievements. It is hoped that this article can spark more research on ICAP's application in Chinese education as well as on how to improve holistic module learning by drawing on the ICAP theory.

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REVIEW

Developing Comprehensive Competences of College Students through Sports: The Role of Slow Pitch Softball Training

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***Abstract**: The cultivation of comprehensive competencies is crucial to college students' development. It is a primary goal of higher education and a need for social development. Currently, issues such as unhealthy mental tendencies, insufficient social skills, and weak social adaptability exist among some Chinese college students. Against the backdrop of promoting college students' holistic development through physical education, this study analyzed the roles of slow pitch softball in boosting college students' key competencies based on the features of this sport and proposed suggestions for optimizing slow pitch softball training in college physical education.*

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Introduction

The development of comprehensive competencies in college students is beneficial to both individuals and society. At present, faced with social transformation and diverse emerging values, a sizeable portion of college students are experiencing a number of challenges, such as psychological issues, interpersonal communication problems, and social adaptation difficulties, which pose negative impacts on college students' holistic development.

The Strategic Plan for the National Medium- and Long-term Education Reform and Development 2010–2020, released by the Ministry of Education of China in 2010, emphasizes that both expertise and physical health development of students should be prioritized in higher education and that schools must ensure that students have ample time for physical education (PE) and extracurricular activities to promote physical and mental health and character building of students (State Council of China, 2010). Recent years' advancement of PE curricular reform has brought about a wider range of PE elective courses in colleges. This article seeks to explore the promotional effects of slow pitch softball on the holistic development of college students and to advance the pathways to successfully fostering their comprehensive competences through slow pitch softball training.

Features of Slow Pitch Softball

Slow pitch softball is a form of baseball that baseball and softball experts have developed from fast pitch softball in recent years by reducing the speed of the ball and changing the fast straight pitch into a parabolic-trajectory pitch. The number of fielders in slow pitcher softball is slightly different from that in fast pitcher softball or baseball. The simplified rules of slow pitcher softball make it easier to play than normative baseball, changes in equipment and field size reduce the difficulty for the players, and the lowered exercise intensity as well as safety risks widen the age range of eligible players. As a result, it becomes a sport suitable for both sexes and many age groups. Since its birth 40 years ago, slow pitch softball has gained popularity in the world, and an increasing number of people are paying attention to baseball and softball because of their exposure to slow pitch softball (Yang, 2021).

Researchers have examined the significance of slow-pitch softball from a variety of perspectives. Yan (1998) argued that playing slow-pitch softball was efficacious in promoting individuals' physical and mental health as well as boosting their brain power and intellectual ability. According to

Du and Zhao (2013), slow-pitch softball is valuable for improving the physical and psychological well-being of the player. Wang (2017) found in his investigation that the baseball and softball training of college students could bolster their social adaptability to a certain extent. Bai (2019) noted that softball was helpful in the construction of campus culture in universities. Features of soft pitch softball are summarized as follows:

- *A Combination of Leisure Activities and Athletics*

Slow-pitch softball, a simplified version of fast-pitch softball, has become highly popular in the U.S. in recent years. Among baseball and softball athletes and individuals with prior experiences in the two sports, 90% of them tend to choose slow-pitch softball as a leisure activity to spend time with their family and friends. As a competitive leisure activity, it has both the characteristics of baseball and softball and its own peculiarities. Its relatively simple rules make it suitable for a wide range of groups (Yan, 1998).

- *Requiring Personal Qualities and Skills*

Slow-pitch softball is a team sport, sometimes requiring the individual player to make sacrifices according to the coach's instructions in order to win. At certain critical moments, it calls on the player's independent decisions, which best reflect their characters, such as courage and quick-wittedness (Wang & Shi, 2011).

- *Contributing to Physical Fitness*

Slow-pitch softball players can improve their physical fitness through scientific training on a daily basis. Through a comparison of the physiological indicators of a young slow-pitch softball player at different points of the game, it can be found that this sport has significantly positive effects on the cardiovascular endurance and strength of the youngster's arms and legs. It is also favorable to other physical qualities such as agility (Liu, 2017).

- *Helping Enhance Personal Psychological Qualities*

Slow-pitch softball, as a competitive team sport, requires tactical coordination during the game and takes a relatively longer time for each match. Psychological adjustment is necessitated before and after the game to address all kinds of challenges, thereby strengthening the psychological endurance of the player (Du & Zhao, 2014).

- *Boosting Teamwork Awareness*

Slow-pitch softball provides individuals with opportunities for interpersonal cooperation and helps foster collective spirits such as solidarity and mutual support in them (Lin, 2023).

- *Improving Employment Prospects*

Slow-pitch softball started to gain popularity in China very recently and is well received among various groups due to its peculiarities. Graduates specializing in slow pitch softball have excellent employment prospects, as they make up for the gap in the supply of talents in this sport in the market (Chen, 2019).

The Status Quo of Comprehensive Competences of Chinese College Students

In their college years, students need to develop not only professional skills and academic ability but also other key competences such as psychological resilience, interpersonal collaboration, and social adaptation to prepare themselves for the challenges of life and work in the future. Nevertheless, research has shown that issues with social-emotional development in Chinese college students are pervasive. According to Guo's and Sun's study, college students have experienced a decline in physical fitness and an increase in mental issues, including but not limited to bigotry, withdrawal, anxiety, and depression, in recent years (Guo & Sun, 2021). Huo (2005) found in his research that college students exhibited concerning levels of social and emotional ability, with 73.9% of them having low levels of social adaptability. Wu's investigation revealed that learning anxiety, communication perplexities, and compulsive tendencies are the main mental issues among college students (Wu, 2018).

Mental Health Issues

College students are typically in their early adulthood, experiencing the most volatile period of their lives. The rapid social development and consequential pressures bring immense challenges to their mental health (Xue, 2022). In this period, college students are striving to develop their thinking and emotional skills. The conflicts between emotion and reason, independence and dependence, ideals and reality, and desire for communication and psychological distancing are accumulating, which can easily induce psychological disorders in them (Tan, 2021). According to Zhang's investigation of 900 college students, 24.03% of them had mental health problems of moderate severity, and 59.28% needed psychological intervention to varying degrees (Zhang, 2012). Chang et al. (2020) conducted a survey on the mental health

state of 3881 college students in Guangdong Province in 2020 and discovered that the incidence of depression among college students during the COVID-19 epidemic was 21.2%, and the incidence of anxiety among them was as high as 26.6%. Hence, mental health issues among college students deserve more serious attention.

Social Interaction Issues

Increased social and economic integration has raised high requirements for individuals' social skills. Qualities such as teamwork, spirit of sacrifice, and excellence in interpersonal communication have become core strengths of individuals and are increasingly emphasized by all sectors and industries. As a pool of talent for socio-economic development, college students should focus on cultivating social skills in various aspects to adapt to the practical needs of social development. However, survey data from *China Youth Daily* showed that 53.66% of Chinese college students tended to feel nervous and embarrassed when required to speak to a large audience; that 52.11% reported feeling uneasy in social activities; that 45.94% would feel nervous when communicating with strangers; that 43.17% would be embarrassed when seeking help from others; that 41.15% may feel uncomfortable when they first arrive in a new environment; and that 33.29% would choose to pretend not to have seen those acquaintances they encounter accidently (China Youth Daily, 2021). These survey results revealed the severity of social anxiety that contemporary college students are suffering from.

Social Adaptation Issues

"Adaptation issues" among Chinese college students are the most prominent in two periods: the initial period of their college life and the finishing period spent on job seeking. Typical adaptation issues in the first period include their incompetence in self-directed learning, their inability to live independently, a lack of communication with teachers, and problematic interactions with classmates. On graduation, how to find a decent job and adapt to the professional life is a new challenge for them. In a relevant survey, 20.9% of college students polled claimed that they had worry about their adaptation to the accelerating social change; 65.9% of them complained about the intense social competition and uncertain employment prospects; 48.9% reported being in a low spirit; 45% declared they were experiencing a sense of emptiness; and 34.3% felt restless (Yang et al., 2014). The survey findings indicate college students' concerns about their positions and situations in society after graduation. In a survey on the social adaptation of college graduates, 44.2%, 17.4%, and 11.1% of the respondents reported that the insufficient stock of expertise, lack of key competences, and problematic work re-

lationships were the top issues they had in the workplace, respectively. 61.6% claimed that they had difficulty adapting to their first job (Yang et al., 2014).

Roles of Slow Pitch Softball in Developing Comprehensive Competences in College Students

Bolstering College Students' Psychological Qualities

In response to academic and life challenges, college students need to constantly adjust their psychological state to release pressure. Slow-pitch softball is effective in fostering courage, self-confidence, and resilience in them.

Cultivating Personal Courage

It takes courage for a college student to confront all imminent and potential challenges. Slow-pitch softball provides them with opportunities to hone their courage. In the softball game, the ball usually flies at a high speed. It may bring great pain to the fielder's body or raise the risk of injury to their face. At times when they fail to catch the ball with gloves, they may have to block the ball with their body to seek more defensive time. Therefore, it calls on both their skills and courage to win the game.

Enhancing Self-Confidence

Slow-pitch softball requires the self-assurance of players in all aspects of the game. Before hitting the ball, the batter faces various pressures, such as the threat of the fielders, the cheers of the audience, and the expectations of their own teammates. At this point, the batter, if not sufficiently confident, may act indecisively when hitting the ball, leading to an improper batting play and affecting the hitting results. Hence, the batter must be absolutely assured of their skills and techniques, maintain positive attitudes, and seize the right opportunity to swing the bat in order to attain optimal performance. As the core of the defense, the pitcher must exhibit strong confidence to gain an advantage over the batter and guarantee ideal teamwork to actualize the established plan. Thus, slow-pitch softball has the potential to enhance the self-confidence of college student players.

Building Psychological Resilience

The development of psychological resilience is imperative for college students, as it aids them in resolving adverse situations and managing adversities and failures in their present college lives as well as in their future careers.

In the process of their engagement in slow-pitch softball, the participants may encounter complications such as adverse weather conditions, incomplete sports facilities, and physical injuries. Colossal amounts of physical output are a test of the players' willpower. In the seven innings, running around the bases repeatedly can exhaust them, which may even result in no scores. Physical and mental frustration is likely to affect their performance throughout the entire game. Through practicing slow-pitch softball, college students can strengthen their capacity to navigate through challenging circumstances, which is beneficial to their future survival and achievement.

Improving College Students' Social Skills

Slow-pitch softball is a team sport, entailing a lot of interpersonal communication. It helps reduce emotional barriers to interpersonal communication among college students. In the meantime, engaging in the game motivates college students to modify their behaviors and to develop their self-concept, thus enhancing their interest in healthy interpersonal communication and social interaction.

Slow-pitch softball improves college students' social skills by enhancing their communication abilities. Tactical planning is of vital importance to slow-pitch softball as it involves multiple links, thereby necessitating large amounts of communication. Every team member plays a crucial role in the game and contributes to its outcomes, making the development of communication skills a key component of the training. The communication during the game includes not only verbal but also behavioral communication such as gestures, eye contact, and facial expressions. The runs resulting from effective communication and collaboration bring players an enormous sense of achievement and boost mutual trust and attachment among them, consequently heightening their interest in communicating with others. Thus, slow-pitch softball is effective in enhancing college students' communication capabilities, which is fundamental to their social skill development.

In addition, slow-pitch softball upgrades college students' social skills by encouraging teamwork. Group work plays a substantial role in strengthening interpersonal relationships. Slow-pitch softball does not depend on a few superstars but rather on the collaboration of all players from all positions to achieve good results. When the batter enters the strike zone, ready to hit the ball, the teammates cheer them on to boost their confidence. If the batter makes the correct judgment about the pitch, their teammates applaud their successful play. If the batter misses the ball, their teammates encourage rather than blame them, which is beneficial for the next hit. When the batter misses three pitches, the encouragement of the team members and the comfort of the coach drive him to hit a good ball in the next round. When there are multiple runners on the field, coordination between them is vital to

avoid two runners grabbing one base, causing unnecessary outs. Collaboration between the fielders is even more important. When catching a fly ball, the player closest to the ball's landing point should shout loudly, clarifying who is to catch the ball to avoid missing the ball or a scramble for it between several players, and teammates in close proximity should be prepared for supplementary fielding where necessary. When catching a ground ball, outfielders must pay more attention to cover in order to catch the ball within the shortest time. A force-out requires close collaboration between the fielders because if one fielder makes a mistake, the situation will get out of control. Slow-pitch softball is a game proceeding at a fast pace and full of accidents, in which mistakes by the players are inevitable. In light of this, mutual support between team members helps boost morale and cheer the team up to play the whole game well. Teamwork is crucial to winning a slow-pitch softball match, and every team member enhances their teamwork capability through the game, which is also a key social skill for college students to develop.

Increasing Social Adaptability of College Students

Cui (2013) argued that participation in sports, especially team sports, had a positive effect on college students' social adaptability. According to Ma (2012), participation in sports significantly impacted the formation and development of characters in college students. Miao's research found that there was a significant difference in social adaptability between sports-major college students and non-sports-major ones in China. Sports majors exhibit significantly stronger social adaptability because qualities such as solidarity, endurance, cooperation, responsibility, and resilience can be well developed through sports training (Miao, 2016). To a certain extent, high levels of social self-efficacy predict proactive social participation in students, while social avoidance is a negative mental state that can be corrected through sports activities.

A key quality emphasized in slow-pitch softball is "perseverance," meaning the team never gives up until the last player is out. Qualities such as self-sacrifice and being supportive of team members are highly valued in this game. Both the offense and defense stress the collective spirit. In addition, slow-pitch softball is an experience-focused outdoor team sport that integrates a variety of challenging elements, underscoring the importance of experience and adaptation among the players. Therefore, slow-pitch softball can potentially play a positive role in fostering social adaptability in college students (Yang, 2021).

Pathways to the Successful Development of Comprehensive Competences in College Students through Slow Pitch Softball Training

The State General Administration of Sports and the Ministry of Education released a report in August 2020 called "*Advancing the Integration of Sports and Education to Promote the Healthy Development of Youth*." It says that all levels of education should offer more sports activities on campus and create or improve school sports teams; that students should be encouraged to join school sports teams and train in their spare time, as well as taking part in local and national leagues; and that higher education institutions should build more sport teams for ball games and expand the team sizes of collective ball games (State Council of China, 2020).. Slow-pitch softball is a competitive, engaging ball game with the potential to provide a unique experience of teamwork. To give full play to its role in enhancing students' overall competence, it is imperative to improve its training quality and increase its popularity in colleges and universities.

Establishing a Complete On-Campus Training Framework for Slow Pitch Softball

A sound training framework for slow-pitch softball in universities should include specialized training courses, complete facilities, and professional training staff. First, establish slow-pitch softball as an elective course in higher education institutions' PE curricula. Second, increase investment in slow-pitch softball facilities. Universities should build specialized slow-pitch softball venues and supply quality equipment to offer students an engaging training environment. Third, introduce professional training staff. Universities can hire professional slow pitch softball coaches from outside the school to provide students with high-quality training and guidance; in the meantime, it is necessary to formulate slow pitch softball training programs for in-service PE teachers to build the school-based pool of slow pitch softball coaches.

Enriching Instruction Methods for Slow Pitch Softball Training

It is advisable to develop a training strategy that pertains to the characteristics of slow-pitch softball. First off, PE teachers should work to create an intriguing exercise atmosphere that is different from the traditional way of harsh sports training, allowing students to experience the fun of slow-pitch

softball. Furthermore, various forms of activities should be introduced into the class, such as simulative matches and teacher-student role swapping, to increase inter-student and teacher-student interaction. In addition, there should be conversations between students and PE teachers after the training sessions to reflect on the training process and formulate improvement measures.

Initiating Diverse Activities Surrounding Slow-Pitch Softball

Slow-pitch softball training can be offered as a public elective course or a basic component of PE courses in colleges and universities. In addition, students should be encouraged to set up slow-pitch softball clubs to host a wide range of after-school activities related to this game. Slow-pitch softball matches and leagues are effective means for popularizing the sport. The slow-pitch softball culture festival on university campuses is also a valuable event for spreading knowledge about the sport and maximizing student participation. More activities like these should be explored to increase the popularity of slow-pitch softball among college students, which contributes to their competence development and character building.

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